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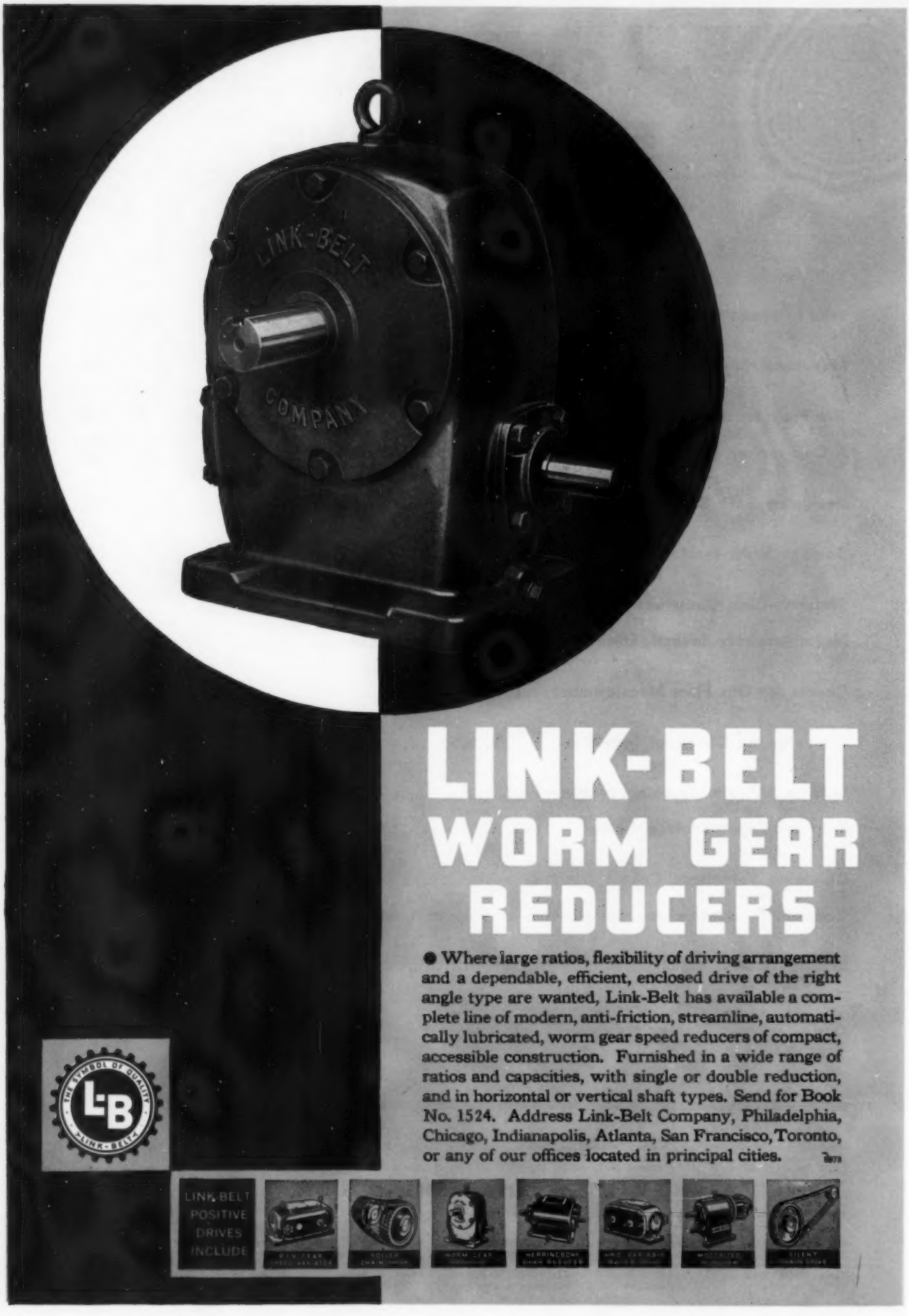
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S. D. KIRKPATRICK, Editor

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March, 1937

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WHO'S RESPONSIBLE ?

WHO'S TO PAY ?

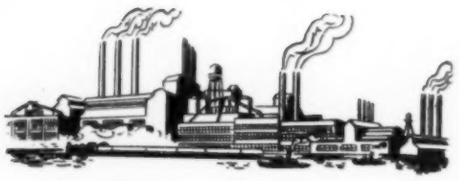
CONGRESS has before it now a baker's dozen of bills designed to regulate or prevent stream pollution. Some of these are certain to be heard from in the process industries because our plants are often charged with serious offenses yet it is questionable if they are always guilty in anything like the degree that is claimed. Nevertheless, the disposal of industrial wastes is more than ever a matter of public concern and the chemical engineer must recognize that he has here a social as well as a technical responsibility.

Judging from recent discussions, in and out of Washington, the most important issue is how far the government should go in the prevention of stream pollution and who shall pay for the corrective measures? Abel Wolman of Baltimore, chairman of the Water Resources Committee, spoke quite frankly on this subject last month to his coal mining friends in A.I.M.E. who argued that the Federal Government should continue to spend several million dollars annually in controlling acid pollution from coal mines. In Mr. Wolman's opinion, "the discharge of waste from mines of one type or another represents perhaps the greatest single source of stream pollution in the United States"—accounting in the aggregate for the discharge of about four million tons of sulphuric acid per year. Continuing, he said: "It is the present writer's judgment that private industry in this and allied industrial wastes fields has not met the problem as completely and as promptly as many of us believe it should. Industry cannot accept taxpayers' funds for the correction of some of these evils without later and extended controls. In the coal mining field, as in other industrial enterprises, responsibility for and financing of waste-recovery processes must rest with industry. It cannot forego its responsibilities and expect the taxpayer to meet the bill."

The problem in many instances in chemical industry is simple economics in which potential gain through byproduct recovery is balanced against actual losses of recoverable materials. In other cases the cost of disposal is a necessary part of the costs of manufacture and must be so apportioned. In a few places, under special circumstances, deliberate pollution may be actually justifiable, for conceivably there are streams that can serve no better use in the public economy. That, however, is something that industry cannot always decide for itself.

But the more important point made by Mr. Wolman is that "engineers cannot afford, particularly in the industrial field, to permit these questions to be settled entirely by the politicians. Industry in this as in other directions has a major responsibility to the public." The chemical engineer must take the lead in the study and development of efficient methods of treating industrial wastes. He dare not lag behind lest his belated research be anticipated by regulatory legislation and drastic dicta. The extent to which Federal and State laws are likely to go in this direction will depend largely on how promptly and intelligently industry acts in accepting the responsibility for a fair measure of cooperation in the public interest.

Sidney D. Kirkpatrick



FROM AN EDITORIAL VIEWPOINT

Fewer Jumps to Justice

PATENT APPEALS from the district courts should go to a single Court of Patent Appeals. This seems the general and the valid conclusion of engineers and patent attorneys who have long experienced the difficulties involved in the present patent procedure. Both engineering and legal groups are, therefore, supporting this idea as it takes legislative form in Congress. But there is far less unanimity with respect to the specific bill proposed by Senator McAdoo of California (S. 475).

A single appellate court, replacing the present circuit courts of appeal with respect to patent litigation, would seem to have numerous advantages. It would eliminate the present cause of greatest dissatisfaction, namely, conflict of decisions between different circuits. Properly organized, a single court would be made up of justices experienced and skilled in handling patent litigation. A more effective, prompt, intelligent, understanding interpretation of the law would follow. And greater finality should attach to the decisions. Fewer cases would have to go up to the Supreme Court for final review.

It is quite a different matter, however, to propose that in our single court of patent appeals there should be a quasi-judicial group of scientific advisers. The McAdoo bill proposes that there be three specialists to advise and assist the jurists in their study of cases and in formulating their conclusions. Under appellate court practices these specialists would presumably work "in chambers" with the judges, and not appear on the witness stand. Their expert comments, whether right or wrong, would, therefore, not be subject to examination or cross-examination by either litigant.

Such a technique might well mean that there would be many appellate decisions based on perfectly honest but grossly biased opinion of the experts. It certainly would handicap every litigant in making a proper record in the trial court. And it might undo the best of services by specialists called on to give expert testimony before the trial courts.

If these scientific experts could be named to assist the jurists in trial courts, there might be great advantage. That proposal, made most conspicuously by the patents committee of the Science Advisory Board, is an excellent one. In due time it is hoped that such a plan for a panel of experts on whom judges hearing patent cases may call for impartial aid will be established. But there is no proper place for scientific experting behind the scenes in an appellate court. If the appellate court wants more facts, let it hold open hearings with impartial experts subject to examination. And let it pick those non-partisan experts for their skill with respect to the particular case at bar. Three specialists to cover all the fields of modern science and technology likely to be involved in patent litigation would be anything but expert in most cases.

On Buying Pigs in Pokes

SEVEN YEARS ago a frequent and thoughtful contributor to the pages of *Chem. & Met.* described an ingenious process of combining stills and evaporators to effect the simultaneous recovery of alcohol and the concentration of distillery slops. An informative flowsheet was included in the article as well as a reference to the United States patents. Imagine this author's surprise last summer in reading one of the foreign papers presented before the International Chemical Engineering Congress to discover a similar if not identical flowsheet, and, more significantly, a reference to a foreign patent taken out subsequent to the appearance of the original article in the December, 1929, *Chem. & Met.*

Since our author had neglected to apply for a patent in this particular foreign country, there was apparently nothing illegal in the appropriation of his ideas. But it is interesting to speculate on what would happen if the original inventor were to build a plant in that country. Presumably he would

be liable for patent infringement on his own process! What would happen, too, if some unwary American were to buy this process in the European market, only to find that it lacked patent validity here? The obvious moral of this editorial then is that it not only pays to take out foreign patents promptly and as widely as possible, but also to watch your step when you buy patentable processes from overseas. Another editorial with an equally obvious moral might be written on the difference between ethical and legal aspects of patent pirating.

And Now, Newsprint for the South

TWO YEARS AGO an enormous expansion program in kraft pulp and paper production started in the South. At the present time ten new mills are under way at a reported investment of $85,000,000 and three others are known to be under consideration. And now comes the announcement of plans for the first newsprint mill in the South. This mill is to be located in Texas and is to be financed by southern interests. The output has been contracted for by southern publishers. Several other newsprint mills are being planned for the states south of the Mason and Dixon Line. Grellet N. Collins summed up the prospects for the southern industry in his presidential address before the Technical Association of the Pulp and Paper Industry last month when he said, "The proposed expansion of pulp and the interest shown in the South is going to have a far-reaching effect. The manufacturing costs of the new mills will be lower and some of the older northern mills will be forced out of business as has already been indicated."

To Where It Belongs

ANNOUNCEMENT that the American Institute of Chemical Engineers will shortly transfer its headquarters to the Engineering Societies Building in New York seems a logical step in the development of our profession. To take its place along with the Founder Societies and related engineering organizations is recognition of an obligation perhaps long overdue. In many of the universities and colleges, registration in chemical engineering has crowded ahead of several of the older branches of engineering—and is still increasing.

To Frederic J. LeMaistre, executive secretary since 1930, must go a large measure of the credit for the efficient organization and recent development of the Institute. During the past seven years when most professional organizations were losing members, A.I.Ch.E. gained more than 60 per cent. To Stephen L. Tyler, who is now to succeed him in this important office, the record is a challenge for further progress in a profession in which the new secretary has many friends and well-wishers.

Plastics Testing to the Fore

COMPETITION between plastics for industrial usage requires a common basis for judgment of performance characteristics. As a first step in the meeting of this need, the American Society for Testing Materials is organizing a new committee on methods of testing plastic materials. This is an important step. It gives real promise that dependable and significant procedures can be developed and used by both producers and users of plastics.

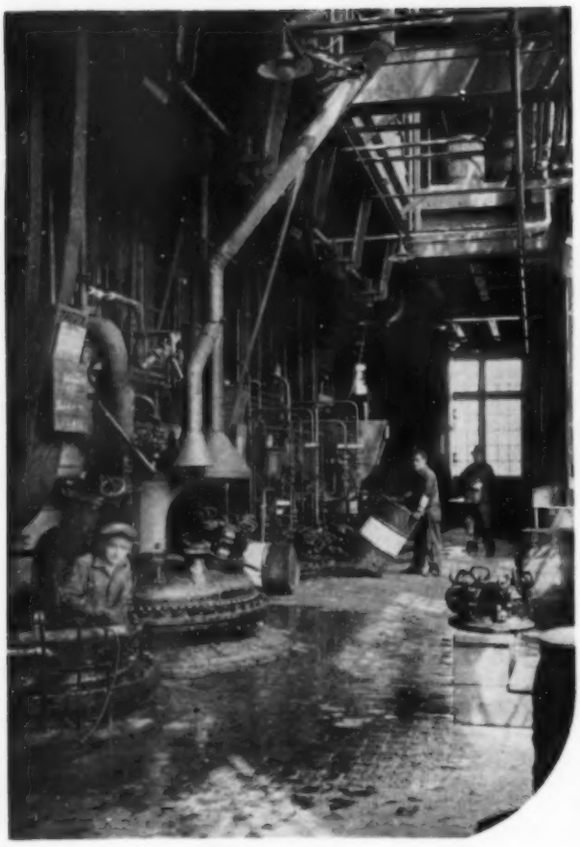
The task being undertaken is not a simple one. It is far too soon to prophesy just how the committee now under organization will work. It is evident, however, that the drafting of specifications is not an immediate, perhaps not even an ultimate, task of this present group. Nevertheless, the work on test methods which is to be undertaken has great importance. Both users and producers should see to it that their technical men afford all possible cooperation whenever they are asked to aid this committee. The ultimate result in standard test procedure will be constructive and helpful for all of the industries and individuals involved.

Price Booms Can Collapse

SEVERAL COMMODITY and raw-material markets are experiencing price booms that will bear careful study. Especially is this true of those commodities required for national defense and preparedness in Europe. A combination of speculation and bonafide reserve-stock building over there has probably been the principal cause of much of the recent rise. But to assume that these increases, either in demand or in price, will necessarily continue, seems a slightly dangerous conjecture. Nothing short of a devastating war could continue the present trends. And even such a war demand may not be permitted to "benefit" commodity purveyors of America.

Just remember that neutrality legislation is in the making in Washington. As this editorial is written, it appears that the President is to be given much discretion as to how neutrality limitations shall be enforced. But there is no doubt that restriction on international trade will come in large measure by a combination of law and Presidential orders. This means that even an active war demand cannot necessarily be counted on to continue to raise commodity prices indefinitely within the United States. It would seem wise to plan accordingly.

Versatility in Dyestuffs



Producing intermediates in the Linden, N. J., plant of the General Aniline Works

THE AMERICAN DYESTUFFS INDUSTRY has made great strides since the World War which cut off our supply and forced the manufacture of the domestic requirements. At present there are several very large plants in this country producing immense quantities of colors for the purpose of dyeing cotton, wool, silk, rayon and other fibers, and such other materials as paper, rubber and synthetic resins. One of the most modern and interesting of these plants is the General Aniline Works located near Linden, N. J. Here between 200 and 300 dyes are produced. In addition 300 to 400 intermediates are made for use in this plant and for conversion into dyes at General Aniline's Albany, N. Y., works, another large producer of dyes. Many textile assistants such as detergents, wetting out agents and stripping agents are also produced in this New Jersey plant.

Dyestuffs manufacturers have the problem of producing a very large number of different colors. While many of the dyes are standard and are consumed in large quantities year after year, many of the colors fluctuate in demand from one season to another due, among other causes, to the constant changing of women's clothing fashions. The producer must be prepared to meet this demand, and to do so economically his equipment must be extremely flexible. To be flexible means that it must be capable of resisting alkaline and acid solutions, high and low pressures, high and low temperatures, and the like. And above all the equipment must be easily cleaned of all traces of the dyestuffs previously processed, for even minute amounts of a color remaining in the kettle or filter press would affect the next batch of colored material that would be put into the equipment.

The company enginees, when designing new equipment, place great emphasis on flexibility and their goal is to make each machine capable of carrying out every type of reaction and operation.

The Linden plant of the General Aniline Works is divided into groups of buildings designated A, B and C. The buildings are arranged in rows separated by broad roadways and railroad spurs. Each block is made up of both large and small brick structures. In most cases the buildings are modern steel and brick or concrete structures, supplied with large windows which give adequate light and ventilation.

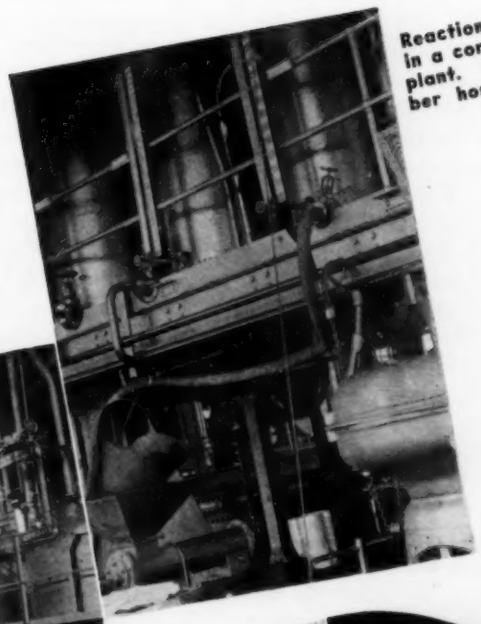
The plant is composed of the power house; machine shop; lead burning shop; cooperage; laboratories (research, control, analytical and semi-commercial scale); manufacturing buildings for black and other sulphur colors; alizarine vat colors; intermediates; soapless detergents, and other textile assistants.

The location of the various operations in the processing depends upon several factors: effect of one dye on another, volume annually produced and nature of the processing, operation or product.

Intermediates for the azo dyestuffs are produced in two buildings, each bridged to a four-story warehouse in between, in which are stored the raw materials for use in the two intermediates buildings as well as the finished products from these buildings.

Equipment

By JAMES A. LEE
Managing Editor, Chemical & Metallurgical Engineering



Reaction kettles in a corner of the plant. Much rubber hose is used

Some of the raw materials are stored in tanks on the third floor of the intermediates buildings. Chemicals flow by gravity to the processing kettles on the lower floors

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Receiving tanks in one of the dyestuffs buildings at the Linden works

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One of the kneading machines in the position of emptying the contents

The warehouse building also houses the control laboratory which is used in guiding the production of intermediates.

The older unit is utilized for the manufacture of intermediates which require a long cycle (two to ten days) for processing. In one section of this unit is a long row of kettles suitable for acid reactions, such as sulphonations and nitrations. In these kettles reactions at temperatures of 0 to 150 deg. C. are carried out. The products are transferred through iron or lead pipe lines by compressed air to diluting kettles or tubs, which are brick lined with the aid of acid resistant cement. In these tubs or kettles, the next step of the separation is carried out by precipitation with salts of various kinds, or by neutralization of excess acid with lime or limestone.

The product is then separated by suitable filter medium, which may be filter presses or brick-lined suction filters. In some instances the processing is completed at this stage, the finished product being discharged into barrels. In other cases the filter

residue is waste material and the product is in solution. It may require further processing.

In this section of the building are located kettles suitably designed for the reduction of nitro compounds to amino compounds. The tubs previously mentioned are also usable for separation of the amino compounds.

The second section of the building is devoted to the alkaline reactions such as fusions with caustic soda or ammoniations. In this section is found an arrangement of batteries of several kettles in each group. These kettles are grouped for reactions without pressure, for reactions involving moderate pressures and for reactions involving high pressures. And, of course, any of these kettles can be used for lower pressures when and if the need occurs.

The flow from the kettles goes to brick-lined tubs, some of which are suitable only for alkaline solutions, others for acid solutions. This last equipment can also be used for processing products from the first mentioned section (acid section).

This flexibility of equipment makes it possible to process from 8 to 14 different products simultaneously. One hundred different products have been made in this building. The third section of the building is the tower in which are stored acids and other liquid raw materials.

The newer intermediates unit in contrast to the older one is intended to accommodate the manufacture of products requiring shorter cycles. Here also are located all intermediates in which solvents are used in the processing, as well as a still for the recovery of solvents either used in this building or elsewhere in the plant. Every piece of equipment is so designed and laid out that it may be regrouped for the process flow of production required at the moment. In this same block of buildings is located the engineering department, machine shops, repair and maintenance organizations.

The principal structures in the next block are two large buildings connected by a bridge housing the control laboratory for the work done nearby. Here vat dyes and alizarine colors are produced. Trucks may drive in on the ground floor of the north building in order to deliver raw materials and receive packages of finished dyes. On the second floor of this building are located the kettles in which the raw material is converted into the dyestuffs. The dyestuffs which are usually in liquid suspension are separated through suitable filter presses located on the third floor. From here they are conveyed in paste form across the bridge to the other building where they are dried or mixed as pastes. The dry-

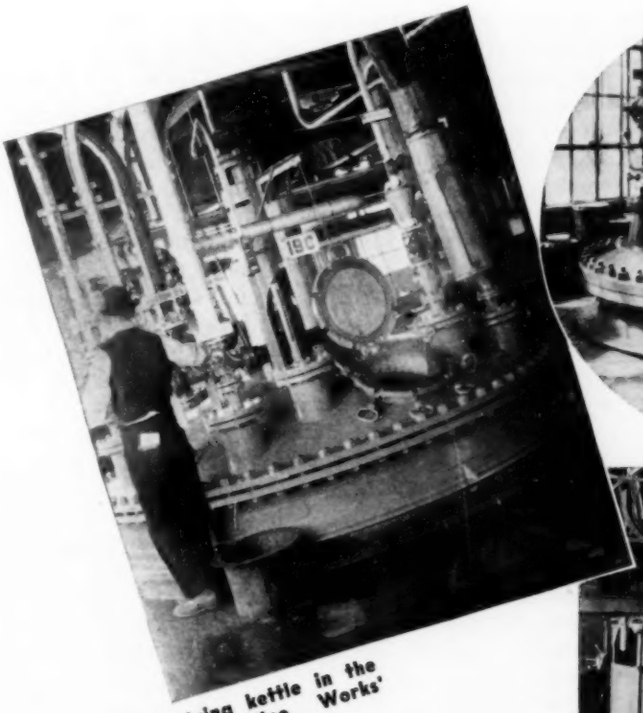
Adequate space surrounds each of the combination vats as is shown in the illustration. Notice the rubber hose which is extensively used to convey both raw materials and compounds being processed

One end of a processing floor in an intermediate building at the Linden works of General Aniline

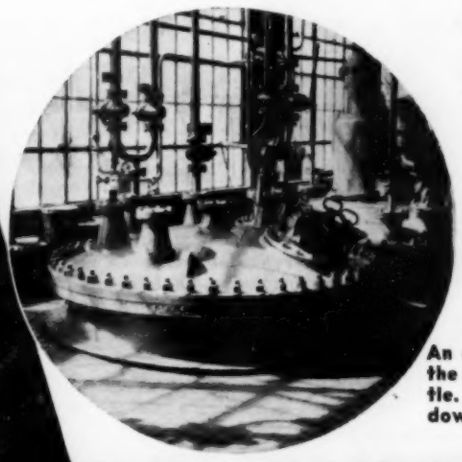
ing is done on the third or top floor, the grinding on the second and the milling on the ground floor. Not only are the pastes from the adjoining building dried, milled or mixed in this department, but dyes and intermediates in the form of pastes from all over the plant are brought here for finishing. There are several types of dryers in use, vacuum shelf dryers, hot air dryers and horizontal, cylindrical dryers in which the paste is stirred by revolving blades until dry.

The remaining blocks include the production of the black and dark blue sulphur colors, warehouse, power house, and administration quarters.

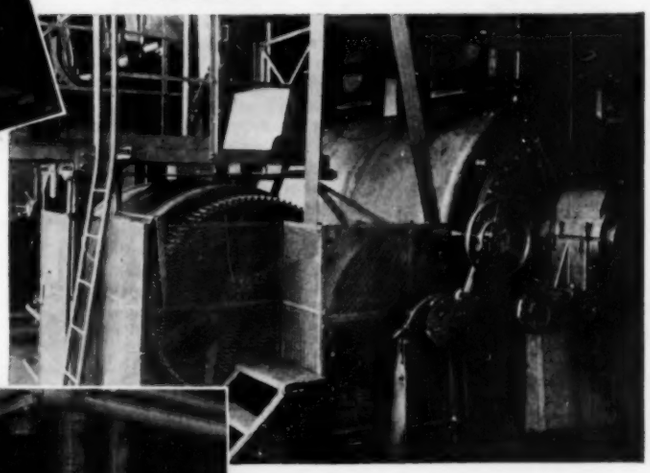
A visitor to the Linden plant of General Aniline is impressed by the many large buildings of modern design and construction and layout of the works.



A dissolving kettle in the General Aniline Works' Linden plant



An operating floor showing the top of a reaction kettle. Notice the large windows that give splendid day-light



A group of ball mills in the finishing department of the Linden plant

Refrigerating units are installed in each of the processing buildings

The Providence Experiment in

JUNIOR ENGINEERS'

Entrance, Providence Engineering Societies building

Our January editorial revealed a surprising interest in helping young engineers to do something to help themselves in their professional development. One *Chem. & Met.* reader wrote as follows: "I hope you will push these ideas through to a worth-while conclusion. Don't just throw the ball into the air and hope somebody will catch it! Give us something definite in the way of a program to work on." That challenge is accepted. Here is an outline of one mighty successful experiment carried out under the sponsorship of a fine group of professionally-minded engineers and chemists. Doubtless other technical groups have similar undertakings. If so, we would be glad to hear about them. If not, don't you think there is an opportunity in your own local section, alumni group or plant organization to get something like this started? The fellows themselves will carry the ball if you will give them a chance!

FILLING THE GAP between college graduation and the time when he becomes established in his profession is one of the important problems facing the young chemical engineer. It is a problem which seems to have been recognized by the young engineers and the profession alike, but one on which very little organized action has been taken. It has been left almost entirely to each individual man to formulate his own program of development during this important period and to find his own facilities and active stimulus for carrying along the continuance of his studies, development of personal qualities, and the establishment of contacts and acquaintances with others in the profession. With an increasing number of young engineers entering industry each year, it becomes more and more apparent that some definite facilities for encouraging personal development should be provided. That is why so much interest and significance are being attached to an experiment along this line which is now in its second year at Providence, R. I.

To the Providence Engineering Society and the young engineers of the Providence area goes the credit for pioneering work in organizing an active group program for junior engineers' development. Today this program includes a general monthly meeting attended by 75 to 100 junior engineers, five self-conducted discussion groups each of which meets monthly or bi-weekly with an attendance of 15 to 30, and also several lesser activities which fit in with the aims of the movement. Known as the Providence Junior Engineers, the organization is open to men in any of the engineering fields. In view of the similarity of interests and needs of all young engineers, it was decided at the time of organization that a more effective program could be worked out on a collective basis rather than having separate and similar programs for the different branches of engineering.

The experiment was launched on March 2, 1936. A picked group of twenty young engineers employed in the Providence area met by invitation with the Providence Engineering Society's advisory committee on junior engineer's development. Amid the congenial surroundings of the Society's private library, the young men were introduced to some of the members of the committee who acquainted them with the purpose and aims of a junior engineers' development program. The committee then offered the use of the Society's rooms, publicity space in its bi-weekly printed bulletin, and any advice or aid which the group might seek should it care actually to organize, direct and carry forward a definite professional development program open to all young engineers employed in the Providence area.

After so stating its proposition and offering its facilities the advisory committee asked each one of the group to state his frank opinion of the plan and just what he would expect to gain from it. This brought forth a number of questions and discussion, as well as some open skepticism. Eventually, however, unanimous agreement was reached to the effect that such a cooperative program held some real possibilities and was certainly worth trying.

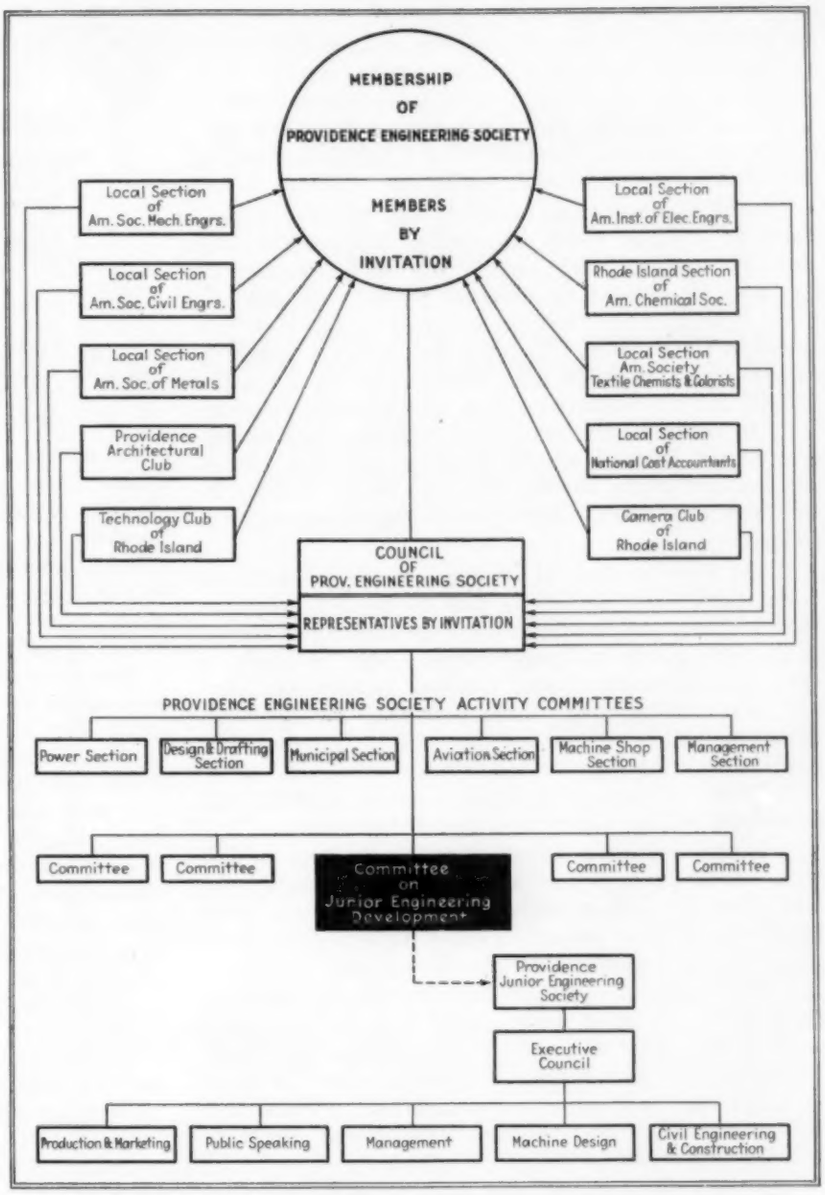
At this point in the meeting the older men withdrew, leaving the junior group to formulate its own plan of advance. The objective of the committee in this experiment was merely to start the activity, for it realized that any group program in junior development would have to be directed entirely by the men in it if it were to succeed. It is significant to note that since this first meeting the Providence Junior Engineers have at no time been directly affiliated with or under the jurisdiction of the Providence Engineering Society. On the accompanying organization chart the line connecting the senior society with the junior society has been cut to

DEVELOPMENT

indicate advisory relationship only.

After this first meeting the group laid out a tentative program and held several general meetings, the first two of which consisted of short talks by some of the members on the type of work in which they were engaged. At the third meeting Edmund C. Mayo, president of the Gorham Manufacturing Co., spoke on the subject, "Where Do We Go From College?" As the meetings progressed the original group of twenty men was being continually augmented by interested friends until the attendance reached 60 at the third meeting.

With a more definite plan now drawn up, the group got in touch with all of the firms in the Providence area and asked for the names of engineers in their employ who were less than five years out of college. About 600 names were obtained. A letter was sent to these men announcing the next meeting, at which the late Gen. R. I. Rees, then chairman of the committee on professional training of the Engineers' Council for Professional Development, was to describe the aims and purposes of E.C.P.D. and outline a suggested program which a junior engineers group might wish to undertake.



Organization of the two Providence Engineering Societies. Relationship of senior to junior society is one of advisory council only

The Junior Engineers movement has gained rapidly in Providence. Last fall, as it moved into its second season, there was some apprehension that the momentum which the organization had acquired might diminish. When young men were again sought after in business, and desirable positions appeared more frequently, perhaps they would no longer feel the need of a group development program.

Aims of Program

Experience has shown, however, that such is not the case. The place which this movement can occupy in the development of young engineers is becoming increasingly well established. The aims of the group are becoming clearer as the process of experiment continues. They may be summarized now as follows: (1) To afford an opportunity for acquaintance with other young engineers, with leading professional and business men, and with the business and economic life of the community. (2) To provide incentive for study and personal development through the medium of group activity. (3) To encourage practice in self expression and clear thinking. These aims are nothing temporary—they are not products of a fad. Neither are they limited in their application to any certain type of individual. They can be of use to any young man starting in engineering or business. Consequently the Junior Engineers' movement should always find a place in professional development.

The most important part of the general program is

the meetings. The general meetings held once a month are usually led by a prominent outside speaker, who sometimes can be prevailed upon to submit himself to an informal question period after his talk. This year the monthly meetings have included talks by outstanding men in teaching, insurance, rubber and textiles.

Typical of the general meetings was the one of February 2, 1937, at which George R. Urquhart, former chemical engineer with Solvay and now president of the Manville-Jenks Co., delivered an informal talk entitled "Planning the Development of a Young Man in a Business Concern." This talk was directed primarily to the young engineer who is interested in preparing himself for an ultimate position of executive responsibility in an industrial concern. Its purpose was to suggest certain lines of self-development which, if carried out conscientiously, should make him better qualified to step into such work. His specific suggestions were as follows:

1. Do a great deal of reading outside of technical fields. Read the classics as well as current literature. Both will help you to acquire an understanding of people, their ways, habits and peculiarities. They will help to show you the value of such qualities as patience, tolerance and perseverance. Each year read the five best-sellers in fiction and the five best-sellers in non-fiction. Keep abreast of important current events.

2. Have hobbies—particularly outdoor hobbies such as sailing, hiking, fishing and the outdoor sports.

3. Continue formal schooling at a university or college. Take in particular a few courses in accounting and finance. An executive engineer without some knowledge of these subjects is badly handicapped. Business law and economics will also be valuable.

4. Make use of every opportunity for varying your daily work. In other words, make your field of actual experience as wide as possible. Also, try to learn something about the jobs of the other people in your company.

5. Become as intimately acquainted as possible with the organization plan, financial status and structure, policies and personnel of your company.

Mr. Urquhart added further to his helpful suggestions by stating what he, as an executive, expected from a junior engineer in his employ:

1. Perform your daily tasks carefully and well, however simple they may be.

2. Think beyond the immediate job at hand. Try to improve upon it.

3. Be willing to make sound and constructive suggestions in a *diplomatic* manner.

4. Be able to assume responsibility and produce concrete and dependable results.

5. Not only get along with but actually inspire your associates.

6. Never say "it can't be done," and don't be afraid to "step in where angels fear to tread."

7. Display genuine enthusiasm for the company policies, personnel and leadership.

The subjects discussed by speakers at others of these monthly meetings include: Control of Time and Self, New Frontiers in Business, and Public Speaking.

In order to find out what subjects were of greatest interest for group discussion and formal instruction, a questionnaire was circulated among the members. Data obtained from 151 returns are summarized as follows:

I.	Interested in papers by junior engineers	129
II.	Interested in group discussions	145
	1. Production control and time study	39
	2. Personnel	26
	3. Air conditioning	26
	4. Marketing	14
	5. All others (34)	64
III.	Interested in formal study	136
	1. Business law	54
	2. Public speaking	43
	3. Cost accounting	23
	4. Differential equations	14
	5. All others (31)	55

As a result of this survey, five informal discussion groups have been organized on the subjects of machine design, management, production and marketing, public speaking and civil engineering. These groups offer excellent opportunities for getting acquainted with other young engineers. Also, the group spirit stimulates study. Actual participation in the program gives practice in organizing thought and self expression.

The management group, which meets every month and has an average attendance of 30, has varied its program with several supper meetings. Discussions have been conducted on the basis of mimeographed notes prepared each time by a different presiding chairman. Fifteen men comprise the group interested in machine design. Members of the senior Providence Engineering Society have been invited to join this group as technical consultants in some of the discussions. The public speaking group of 15 men meets every two weeks and at each meeting every member is expected to give a three-minute talk on any subject of interest to him. There has been marked progress in confidence and clarity of speech resulting from these meetings.

As the organization has progressed several other activities have been added to the program. An employment file is being started which will assist members in finding positions best suited to their individual desires and qualifications. Two plant inspection tours have already been made and it is planned that these will form a more important part of the program in the future. Social events have been proposed but the tendency at present is to limit activities rather strictly to the professional side.

Since the Junior Engineers movement is designed for men between one and five years out of college, it is essential that a system be evolved for maintaining a succession of young men to carry on the activities of the group. Toward this end a plan of personal contact by a visiting committee has been established with those near-by firms which employ college graduates. Such contacts will have the two-fold purpose of providing new members each year and also acquaint men in responsible positions with the Junior Engineers.

The financial arrangements of the Junior Engineers provide that members of the Providence Engineering Society and members of national societies affiliated with the Providence Engineering Society will pay no extra fees for membership in the Junior Engineers' group. All other Junior Engineers will pay a fee of $2 a year to cover operating costs, notices and other expense. The Junior Engineers have the use of the rooms and library of the Providence Engineering Society without charge.

A Comparison of PROCESS ECONOMIES in the ALCOHOL INDUSTRY

By GUSTAVE T. REICH

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IN VIEW OF the large commercial growth of the alcohol industry during recent years, and the comparatively little technological progress which has accompanied it, particularly along lines of process economy, attention might be called at this time to a process for fermentation alcohol manufacture which first received brief mention in *Chem. & Met.* in December, 1929, As a result of its departure from the orthodox in method of recovery of the alcohol and concentration of the slop from the ferment, the process is able to offer some interesting economic contrasts with present procedure in the industry. Also of interest is its applicability to the recovery of volatile products in some other fields. The principle involved and certain details of the equipment are covered by U. S. Patents 1,599,185 (1926), 1,930,861 (1933), 2,010,929 (1935) and several more now pending.

The manufacture of alcohol by fermentation uses either molasses or grain as a starting raw material. In either case the standard process is the same: fermentation, recovery of alcohol from the ferment (called "beer") by distillation with live steam which condenses in the still, and finally either direct disposal of the slop from the bottom of the still or its concentration in a multiple-effect evaporator for byproduct recovery. The improved process described in this article eliminates the beer distillation operation entirely. The material from the fermenters, instead of going to a beer still where only alcohol is removed, is sent directly to a triple-effect evaporator where recovery of alcohol and concentration of slop take place simultaneously. This combining of slop concentration and alcohol recovery into one operation has been found to cut down by 35 per cent the quantity of material processed per gallon of alcohol recovered.

For a more detailed description of the process and a quantitative comparison of it with the standard procedure, let us consider the manufacture of industrial ethyl alcohol from molasses. The standard method used almost universally in the industry today, consists of first

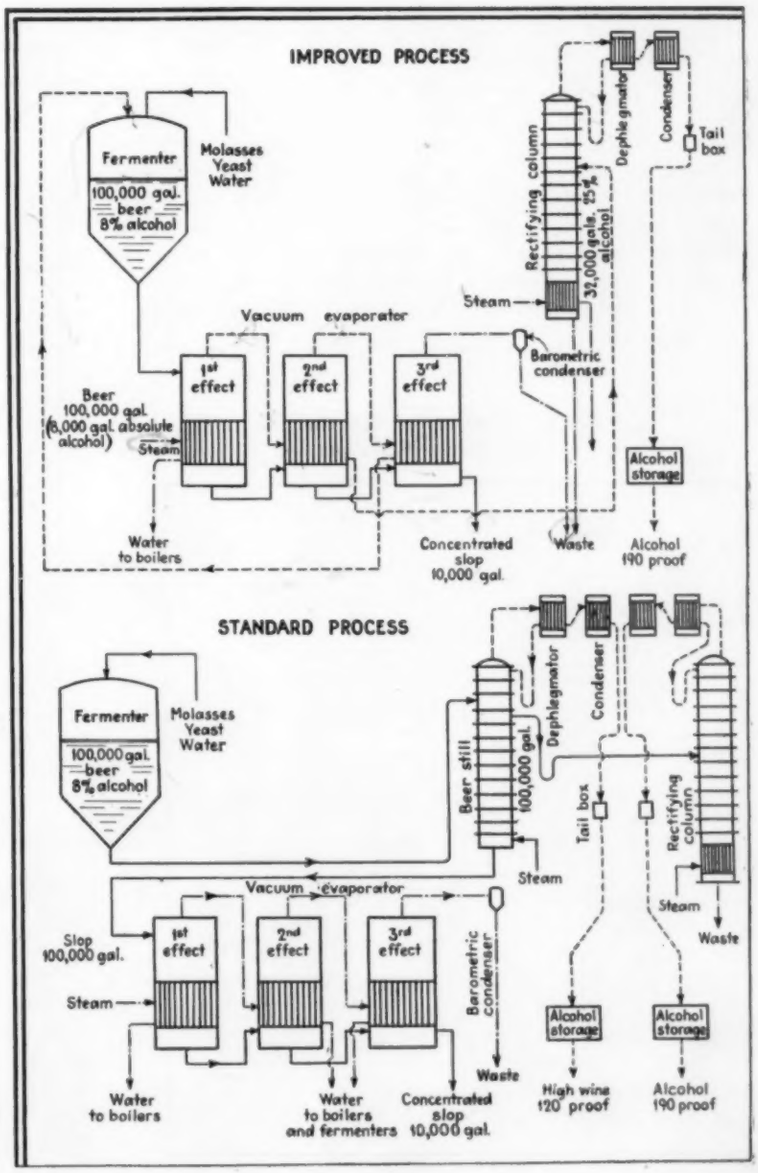
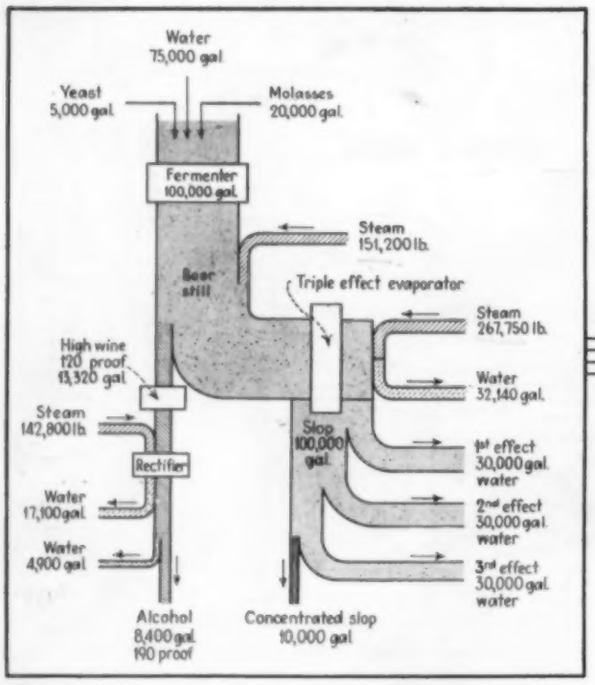


Fig. 1 — Comparative flowsheets bring out basic differences between the two processes for fermentation alcohol recovery

diluting the molasses with water to approximately five times its original volume. After the addition of sulphuric acid for the inversion of sugar, and the addition of yeast food such as ammonium sulphate and phosphate, the sugar solution is fermented to a beer with an alcohol content of approximately 8 per cent. From the fermenters, the beer is pumped through heat exchangers to the beer still (see Fig. 1) where it is de-alcoholized with live steam, the top product being a "high wine" distillate of approximately 120 proof (60 per cent alcohol by volume) and the bottom yielding a watery slop, free of alcohol. The high wine then passes into the aldehyde column in which most of the aldehyde heads are removed. The residual alcohol, very low in aldehydes, but still containing the fusel oil (a mixture of higher alcohols, mostly amyl), passes into the rectifying column where the remainder of the aldehydes are separated in vapor form and the alcohol at 190 proof and the fusel oil are recovered as liquids. The water in the high wine passes out of the bottom of the still as waste. On the average, 36 lb. of steam are required for the production of one gallon of 190 proof alcohol. Approximately 18 to 20 lb. of this are required in the beer still for producing a high wine, and 16 to 18 lb. are required in the rectifying unit.

Until recently, the disposal of the molasses slop has been considered as merely a local problem. Plants located along rivers where the enforcement of rules against stream pollution is not strict, find it convenient to run the dilute slop into the river. Where this practice is restricted by legislation or where such convenient disposal facilities are not available, the slop must be concentrated and either burned for the recovery of nitrogen and potash or dehydrated for sale as fertilizer or feedstuff.

Fig. 2—Quantitative flow diagram for standard process



The growing tendency is toward concentration of the slop for byproduct recovery. This usually is accomplished in a multiple-effect evaporator. As has already been stated, one gallon of alcohol produced from molasses requires 18 to 20 lb. of live steam in the beer still. Enough of this steam condenses within the still to approximately replace the volume of high wine removed, so that 100,000 gal. of beer going into the still will yield 100,000 gal. of de-alcoholized slop. Concentration of this slop down to 10,000 gal. by means of a triple-effect evaporator requires about 267,700 lb. of steam. This amount, along with the 36 lb. per gal, required for the 8,400 gal. of 190 proof alcohol produced, will result in a total steam requirement of 570,100 lb. per 100,000 gal. of beer processed.

Fig. 2 shows graphically the volume flow of materials through the plant operating according to the standard process. In order to produce 8,400 gal. of 190 proof alcohol (8,000 gal. absolute) plus 10,000 gal. of concentrated slop, it is necessary first to de-alcoholize

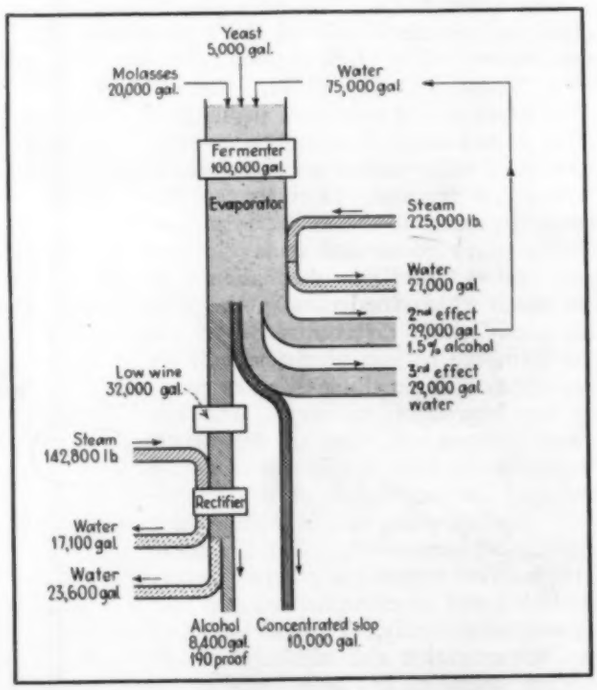


Fig. 3—Quantitative flow diagram for improved process

100,000 gal. of beer, and afterwards concentrate 100,000 gal. of slop, resulting in a total volume of 200,000 gal. of material processed.

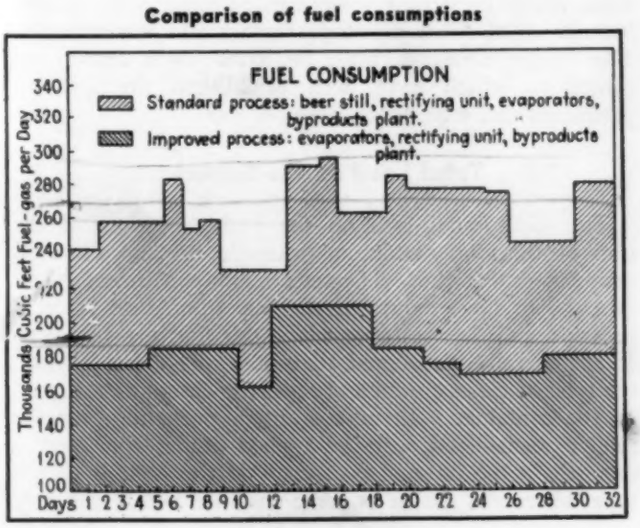
Now let us consider the economic picture presented by combining the alcohol distillation and slop concentration into a single operation carried out in a multiple-effect, direct-current evaporator. The first large-scale test of this process was made in 1925. It was carried out in a triple-effect Zaremba evaporator, each effect being provided with a 38½-in. by 88-in. steam chest

containing 760, 2-in. I.D. copper tubes. The steam inlets were 8 in., 12 in. and 14 in. respectively.

The present plan of the improved system is shown in Fig. 1. The first evaporator effect, which operates at approximately 5 lb. gage pressure, corresponds to the beer still in the standard process. The other two evaporator effects operate under vacuums of 12 in. and 27 in. respectively. In the standard method, when only the de-alcoholized slop is handled in the evaporator, each effect will evaporate 30,000 gal. of water per 100,000 gal. of feed to the first effect. But in the combination process, where the feed is a fermented beer containing 8 per cent alcohol by volume, the evaporation in the first effect will be somewhat more than in the other two because of the difference between the latent heats of alcohol and water. Practically all of the alcohol present will vaporize in the first effect, as will also enough water to yield a condensate of approximately 25 per cent alcohol in the steam chest of the second effect. This "low wine" condensate, entirely free from solids, passes directly to the rectifying still. The vapor from the second evaporator effect contains the remainder of the alcohol, along with a large amount of water. Upon condensation in the steam chest of the third effect, it yields a 1½ per cent alcohol solution which goes back to dilute the next batch of molasses going into the fermenter. Along with this may be sent the dilute alcohol solution from the CO_2 scrubbers if a dry-ice manufacturing unit is operated in conjunction with the process. The small amount of alcohol serves as a nucleus for fermentation of the new batch.

Fig. 3 shows graphically the volume flow of material through the plant when alcohol recovery and slop concentration proceed simultaneously. Fuel economies by the use of heat exchangers were not taken into consideration in either Fig. 2 or Fig. 3. Numerical quantities are indicated merely to show the approximate quantitative relationship between the materials involved in the various steps of the processes. The exact amount of steam required, rate of evaporation and size of evaporator vary greatly. In cases where the liquors contain a large amount of solids, these should be taken into account. It is necessary that precautions be taken against foaming and against retardation of evaporation caused by the presence of non-condensible gases. Fermented beer contains a high percentage of carbon dioxide, so that a properly designed evaporator is essential in order to avoid excessive loss of alcohol. Since de-alcoholization of the beer in the first effect is carried out under almost the same conditions as in the beer still, the quality of alcohol is not impaired. The use of fractionating columns between the various effects may at first glance appear to be desirable, but the benefits derived from such an arrangement are not great.

Comparison of fuel consumptions



In the standard process using a beer still and triple-effect evaporator, 200,000 gal. of liquid were handled for the recovery of 8,400 gal. of 190 proof alcohol and 10,000 gal. of slop. For this same recovery the above described process requires an evaporator for the handling of 100,000 gal. of beer, and a rectifying column for the distillation of approximately 30,000 gal. of low wine. Thus, a plant using the multiple-effect, direct-current principle has 70,000 gal., or 35 per cent, less liquid in process. Fig. 4 shows a comparison of fuel consumption by the two methods. Two different thirty-day periods are represented, but operating conditions during each were similar enough to make them comparable.

In addition to fuel savings, elimination of the beer still decreases the amount of water required for condensation of the alcohol. Labor costs will be less because there will be one less operation; the men who operate the evaporators can operate the rectifying still. Capital investment will be less because a smaller building and a smaller boiler house may be used.

The source of steam supply is a consideration which is always important in distilleries. Molasses distilleries that are incinerating their concentrated slop find it advantageous to combine the incineration with their steam generating plant, thereby producing sufficient steam for their vacuum evaporators.

The recovery of values from grain distillery slop is more difficult than from molasses slop because of the large amount of dissolved and suspended solids present. According to standard procedure, the slop coming from the beer still is stripped of its suspended solids by means of traveling screens and continuous filters. The resulting thin slop contains solids in solution or in a very fine suspension or emulsion which cannot be recovered easily by screening or filtering. Many distilleries do not attempt to recover these, but those which do, use a triple or quadruple effect evaporator for the main evaporation and a single effect finishing column for final concentration. This method leaves much to be accomplished in the way of economy.

With an evaporator properly designed to take into consideration the thermal conductivity, viscosity and specific gravity of grain mash, the fermented mash or beer can be de-alcoholized completely in the presence of the suspended solids and the thin slop concentrated at the same time. The de-alcoholized and partly concentrated slop can be freed of its suspended solid contents and then evaporated to the desired density.

There are various such process combinations possible, each eliminating the use of the beer still and operating the whole unit in such a manner that the recovery of alcohol, when value is considered, would appear to be incidental, and the recovery of solids from the beer, the main purpose.

Designing Soft Copper Gaskets for High Pressure Equipment

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VARIOUS METALS including copper, Armco iron, Swedish steels, Monel metal, nickel, tin, aluminum and lead are used as gaskets for sealing pressure containers. Each of these metals has specific applications where its use is advantageous and in some cases imperative. Selection of the proper gasket material must be governed by the peculiar condition of pressure, temperature, corrosion, and so on, to which the gasket is exposed.

High grade copper, 99+ per cent pure, is generally accepted as the best gasket material for the higher pressures and it is widely used for this purpose. It can readily be soft annealed in which state it has a relatively low cold flow point. This is a very important characteristic since a metal gasket must depend upon cold flow to produce a gas tight joint. Copper gaskets can be protected from corrosion by a plating of nickel, tin, silver, or other metal.

Any study of the design for a gasket involves also a study of the joint construction and the design of the closure. In general, copper gaskets may be classified with reference to joint construction as confined, unconfined, and partly confined. Confined gaskets may be defined as those which have no freedom of flow except for a slight clearance in the joint, unconfined gaskets as those entirely free to flow at their outside and inside peripheries, while partly confined gaskets are a combination of the confined and unconfined. Gaskets may also be classified as those with constant bearing area and those whose bearing area increases as the gasket is compressed. Confined gaskets must have a constant bearing area while unconfined and partly confined gaskets may have either a constant or an increasing bearing area.

Various convenient types of joint construction for flat copper gaskets for high pressures are shown in Fig. 1. In all of these joints the gasket is placed as near as possible to the inside periphery of the container, an important detail, whereby the external force required to seal the joint is kept to a minimum. A small circular "V" groove, with a diameter equal to the mean diameter of the gasket, is cut in the bearing surfaces of both the cylinder and the head. These grooves aid materially in obtaining a pressure-tight joint. Any of the joints shown can easily be incorporated in the design of closures for pressure vessels. Two very good methods of closure for high pressure containers are shown in Fig. 2. Here the bolt pressure is directly above the gasket and the only bending in the head is caused by the internal pressure which can be closely determined.

The design of flat copper gaskets should be based upon the maximum unit internal pressure, that is, the pressure at which the container is to be tested. A test pressure of 1½ times the working pressure is ample for working pressures of 5,000 to 10,000 lb. per sq.in.; above 10,000 lb. a test pressure of 5,000 lb. per sq.in. in excess of the working pressure is sufficient. Since the design of the gasket is based upon actual test pressure, the head and other parts of the closure should be designed for this same condition, in which case higher stresses may be used than in the ordinary design that is based upon working pressure.

The primary purpose of a gasket is to fill up the small inequalities and irregularities in the surfaces between which it is compressed. In order to do this the gasket must be subjected to an initial compressive force sufficient to produce some cold flow of the gasket material. Since the gasket must prevent the leakage of the internal pressure through the joint, it is necessary that the initial gasket pressure be such that, after the internal pressure has been applied, there will still remain sufficient residual pressure upon the gasket to keep the joint absolutely leak-proof. Hence there must be some relation between the residual unit gasket pressure and the internal unit pressure.

For the design of copper gaskets it is necessary to have some knowledge, first, of what the total initial load upon the gasket will be; second, what residual unit gasket pressure should be maintained; and third, what initial unit gasket pressure should be used. None of these vitally important points can be exactly determined because of the indeterminate factors and uncertainties. The design therefore must be based upon certain assumptions which have been established through experiments and experience.

Total Load on the Gasket

The total initial load on the gasket consists of the sum of the total maximum internal load and the total residual gasket load. The total maximum internal load is equal to the product of the maximum unit internal pressure and the area over which this unit pressure acts. It is generally considered that this area depends upon the type of closure used and upon the design of the head of the container. In making up a pressure joint the total external load must be applied before the joint is exposed to the internal pressure. If the joint is of the type where the gasket is some distance within the bolt

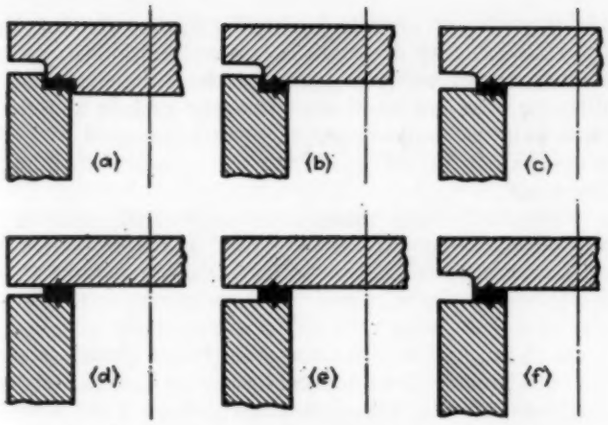


Fig. 1—Types of high-pressure gasket joints with the gasket confined in (a), partly confined in (b), (c) and (d) and unconfined in (e) and (f); joints (a), (b), (c) and (f) have constant bearing area, joints (d) and (e) increasing bearing area

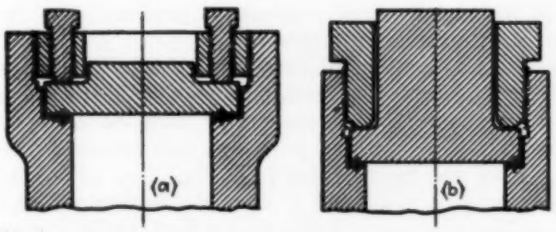
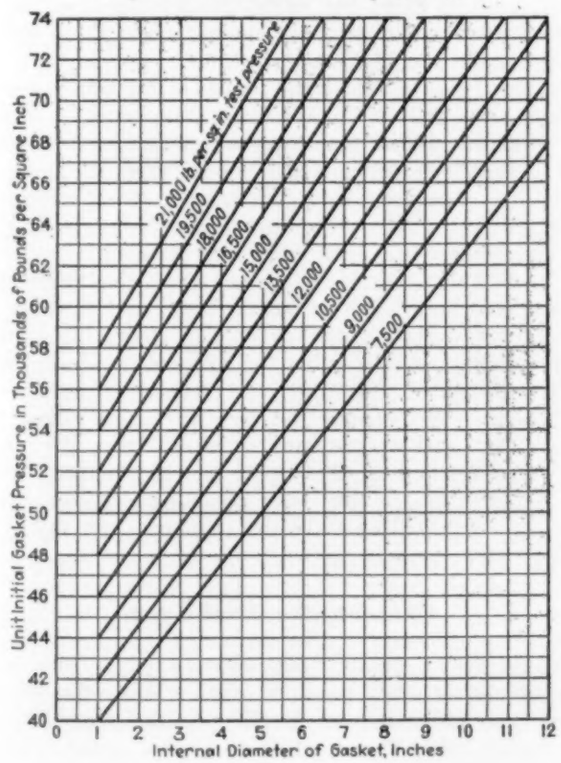


Fig. 2—Closures for pressure vessels; (a) for 5,000 lb. per sq.in. in 16 in. and 11 in. I.D. vessels, and 15,000 lb. per sq.in. in 4¼ in. I.D. vessels; (b) for 5,000–15,000 lb. per sq.in. in 2¼ in. I.D. vessels and smaller

Fig. 3—Initial gasket pressures for various sizes of gasket at various test pressures



circle, the application of the external load will cause a definite deflection of the head. When the internal pressure is applied a different condition of loading results and consequently there occurs a different deflection of the head. This might result in a final deflection of the head at the gasket so great as to allow the internal pressure to leak partially through the joint and thus produce a pressure area greater than that figured from the internal diameter of the gasket. By designing the head of the container so that the deflection above the gasket is practically the same for both initial and final conditions of loading, the pressure area can be definitely fixed as the port area of the gasket. When the applied external force is directly above the gasket, as shown in Fig. 2, there can be little or no deflection of the head above the gasket and therefore the pressure area is the port area of the gasket.

For low pressures and large diameter gaskets where the gasket area is small in comparison to its port area, it would make little difference whether the pressure area was figured from the inside, the mean, or the outside diameter of the gasket but for high pressures and small diameter gaskets where the gasket area is large in comparison to its port area, considerable variation in the total internal load would result.

Residual Unit Gasket Pressure

The residual unit gasket pressure or the unit gasket pressure that must be maintained to keep the joint tight after the internal pressure has been applied is a vital factor in gasket design. As mentioned before there must be some relation between this unit residual gasket pressure and the unit internal pressure.

Various designers differ as to what this residual unit gasket pressure should be, but all agree that it must be at least equal to the internal unit pressure. U. S. Navy Department designers use a residual gasket pressure of 1.25 times the internal pressure, C. O. Sandstrom (*Chem. & Met.*, **40**, 1933, p. 70) gives 1.5 times and Karl Bauman (*Proc. Inst. Mech. Engrs.*, Dec., 1930, p. 1317) claims that for steam this residual pressure should be at least twice the internal pressure. In all these cases, however, the bolt strength is made sufficient to produce a greater residual unit pressure than that mentioned.

In order to determine what the residual gasket pressure should be, experiments were made upon unconfined soft annealed copper gaskets (1¾ in. outside diameter and 1½ in. inside diameter) located between the head and the open end of a cylinder in such manner that the bearing area of the gasket would remain constant under any load. A known external force was applied upon the head directly above the mean circumference of the gasket, by means of a hydraulic press. An increasing gas pressure was then slowly introduced into the cylinder until a leak occurred or the gasket was blown out.

From these experiments it was found that as the initial unit gasket pressure increased from 16,500 to 31,500 lb. per sq.in., the ratio of residual unit gasket pressure to internal unit pressure decreased from 1.18 to 0.55 at the time of failure. With 31,500 lb. per sq.in. gasket pressure a $\frac{6}{64}$-in. thick gasket was blown out when the internal pressure reached 9,500 lb. per

sq.in., the residual unit gasket pressure at failure being 0.55. This gasket had been compressed approximately $\frac{1}{64}$ in. by the initial pressure. Since the type of joint used in these experiments was the unconfined constant bearing area type, Fig. 1 *f*, where the gasket was exposed to the most drastic conditions possible, it is certain the results can be used also as a basis for determining what residual unit gasket pressure should be used for the confined and partly confined gaskets which are exposed to conditions that are less severe. The experiments indicate that a residual unit gasket pressure of 1.25 times the maximum unit internal pressure is sufficient to produce a pressure tight joint if the initial gasket pressure has produced a flow of the copper gasket.

Initial Unit Gasket Pressure

How much pressure is required to produce cold flow of flat copper ring gaskets and how much flow is necessary cannot be definitely determined. The resistance of the gasket to flow varies with the area, the thickness, the ratio of width to internal diameter, the freedom of flow, extent of flow, and the original physical characteristics. With so many variables of such indeterminate character it is evident that the selection of any definite gasket pressure can only be approximate.

The physical characteristics of annealed copper are generally given as about 25,000 lb. per sq.in. ultimate strength, a poorly defined proportional limit of about 8,000 lb. per sq.in., and no definite yield point. Thus, for the range of pressures herein mentioned, with the condition that the residual unit gasket pressure must be at least $1\frac{1}{4}$ times the maximum internal unit pressure, the gaskets will always be stressed above the proportional limit and therefore will not show elastic qualities as such qualities are generally understood. Very little is known about the action of metals when stressed above their elastic limit.

Actual experience with two gaskets of the types shown in Fig. 1 *c* and *e* has shown that the initial unit gasket pressure was so great that it deformed the steel contact surfaces between which the gaskets were compressed. Examination of the deformed metal surfaces shows that the initial load on the gasket was not uniformly distributed but in the absence of knowledge of how this distribution takes place, the initial gasket load must be regarded as uniformly distributed. In each of these cases the gaskets retained sufficient thickness to seal the joints gas tight against pressures of 15,000 and 20,000 lb. per sq.in. From this it must be concluded that the copper gasket could never be entirely squeezed out from between the contact surfaces and that the maximum initial unit gasket pressure is limited by the compressive strength of the metal contact surfaces. These gaskets, although they showed some hardening owing to cold working, could be scratched deeply with the blade of a knife. Thus there occurred the peculiar condition of the softer metal actually deforming the harder one. Explanation of this condition is that copper under high compressive forces acts partially as an elastic solid and partially as a fluid. (See E. V. Crane, "Plastic Working of Metal," Chap. 10. John Wiley & Sons, Inc., 1932; and A. Nadai, "Theory of Plastic Deformation of Ductile Metals," *Physical Review*, 36, pp. 762-772, Aug. 15, 1930.) If the condition of partial fluidity started with pressures just above the elastic limit, then the apparent resilience in copper gaskets and their successful use could be more easily understood. Unwin gives 54,000 lb. per sq.in. for the pressure of fluidity for copper.

Compression experiments on small area gaskets of constant bearing area type (Fig. 1 *c*) showed that deformation took place at an increasing rate up to about 50,000 lb. per sq.in., above which deformation continued but at a decreasing rate. This was true for all gaskets from $\frac{1}{32}$ in. to $\frac{1}{8}$ in. thickness, the thicker gaskets showing the greater deformation in percentage of original thickness. Similar experiments on gaskets of the increasing bearing area type (Fig. 1 *e*) showed the same general trend in their deformation but the deformation in percentage of original thickness was considerably smaller for the same unit pressures. In all cases some permanent deformation had taken place at a gasket pressure of 10,000 lb. per sq.in. With large area gaskets very large initial unit gasket pressures produce a relatively small amount of deformation.

From examination of large area gaskets which have proven satisfactory by tests, it is evident that only a very small amount of deformation or flow of the copper is necessary to seal the joint. A soft annealed copper gasket, of the type of joint in Fig. 2 *a*, 16 in. inside diameter, $\frac{1}{2}$ in. wide and $\frac{1}{8}$ in. thick, sealing a container which had been successfully tested to 8,000 lb. per sq.in. internal pressure, showed a deformation of only 6 per cent of its original thickness after being exposed to a gasket pressure of at least 75,000 lb. per sq.in. An 11-in. gasket, $\frac{3}{8}$ in. wide and $\frac{1}{8}$ in. thick, under exactly the same conditions was deformed about 14 per cent by approximately 70,000 lb. per sq.in. gasket pressure. In both these cases the metal contact surfaces, which were chrome vanadium steel, showed no signs of deformation under the high unit pressures.

In the design of flat copper gaskets for containers of various sizes and for 5,000 to 15,000 lb. per sq.in. working pressures, initial gasket pressures ranging from 40,000 to 75,000 lb. per sq.in. have been used, the designer using his experience and judgment as to the type of joint, thickness of gasket, and the definite initial unit gasket pressure for each individual problem.

Based upon information gained through experiment, experience, knowledge of actual tests, and a study of the indeterminate factors involved, a chart, Fig. 3, has been constructed as a guide for selecting the initial unit gasket pressures for different internal diameters of gaskets and for various test pressures. By using the initial unit gasket pressures obtained from the chart the necessary flow of the copper can be produced without deformation of the metal contact surfaces and the total load required to make the joint pressure tight can be kept to a minimum.

Choosing the Joint Type

All types of gasket joints shown have been used successfully in high pressure work. With the unconfined type (Fig. 1 *e* or *f*) there is the possibility of the gasket being blown out if the initial gasket load is

insufficient, while with the confined or partly confined types the worst that can happen is a slow leak of the pressure through the joint. Owing to the uncertainty of knowing just how much initial gasket pressure is obtained when making up the joint, it is advisable to use the confined or partly confined types.

For gaskets of the confined or partly confined type with constant bearing area (Fig. 1 *a*, *b*, or *c*) the initial gasket pressure is directly proportional to the load. This is not true for the partly confined type with increasing bearing area (Fig. 1 *d*). However, in the latter case, if the area of the gasket is large it will be deformed very little under high unit pressures and consequently its increase in area will be extremely small.

With each type of joint the resistance of the gasket to flow varies somewhat owing to the different degree of confinement so the designer, by selecting a certain type of joint, can obtain slightly more or less flow for the same initial gasket pressure. By varying the thickness of the gasket slightly, this same object may be attained, thick gaskets showing less resistance to flow than thin ones. As an empirical rule, the thickness of the partly confined gasket should be about 1/5 of its width with a maximum thickness of $\frac{1}{8}$ in. For the confined type of joint, the thickness of the gasket is not important since the gasket cannot be forced through the small clearance spaces even when subjected to extremely high unit pressures.

Design of Copper Gaskets

Having decided that the initial unit gasket pressure can be selected from the chart, that the residual unit gasket pressure must be at least 1.25 times the maximum internal unit pressure, and that the area exposed to internal pressure is the same as the port opening of the gasket, the following formulas will be useful for designing flat copper gaskets:

$$L = \frac{\pi D^2}{4} P_T + 1.25 P_T a = P_o a$$

$$a = \frac{\pi D^2}{4} P_T / (P_o - 1.25 P_T)$$

Here L = total initial load upon the gasket, in pounds; D = internal diameter of gasket, in inches; P_T = maximum internal unit pressure (or test pressure) in pounds per square inch; P_o = initial unit gasket pressure, in pounds per square inch, as selected from Fig. 3; and a = area of the gasket, in square inches. From the second equation the area of the gasket can be found. Knowing the area and the internal diameter, the external diameter and the width can be determined. The minimum width of gasket is assumed to be $\frac{1}{8}$ in., so if the calculated width is less than this amount, a gasket $\frac{1}{8}$ in. wide is used. The total load is then the product of the gasket area and the initial unit gasket pressure shown on the chart.

Savings With Insulating Refractories

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REMARKABLE fuel economies have become possible in recent years through the use of insulating refractories in the construction of furnaces. Although this practice has contributed to notable fuel bill reductions in all sorts of furnaces, savings are particularly marked in intermittently operated furnaces, for these new refractories, in addition to their high insulating qualities, have the property of extremely low heat storage capacity in comparison with refractories of other types. Thus a furnace constructed from them, or from a thin lining of other refractories, plus a layer of insulating refractories, becomes extremely responsive to temperature control, heats up rapidly from a cold start, stores relatively little heat in its walls, and cools rapidly when it is shut down at the completion of its operating cycle. As a result, users of such furnaces have found heating time decreased by a half or more, and fuel consumption reduced in the same proportion. One case is reported in which a 48 x 72-in. hearth furnace, constructed of these refractories, required burners using less than 300 cu. ft. of gas per hour to maintain a temperature of 1,800 deg. F., whereas the burners used previously on furnaces of the same design, built entirely of firebrick, required 1,350-1,500 cu. ft. per hour.

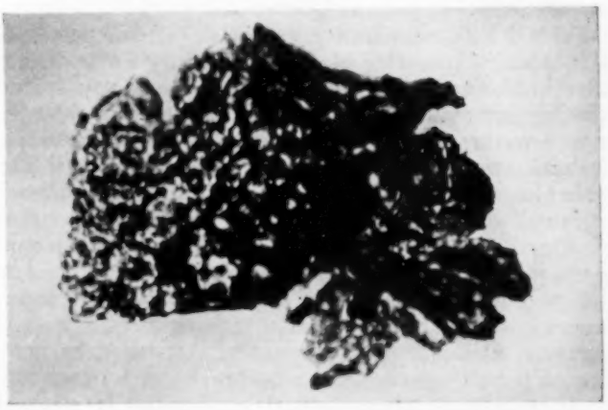


Fig. 1 — Particle of expanded fireclay, magnification about 2,000 diam. as reproduced (Photomicrograph by Bowman-Weiner)

The insulating constituent of this new type of refractory is Insuline, a light-weight insulating material of high refractory character, made by expanding fireclay so that it contains a tremendous number of microscopic, unconnected cells. A single particle of this material is shown, highly magnified, in Fig. 1. Crushed to give the proper distribution of particle sizes and mixed with a suitable binder, Insuline is now being used in producing a variety of insulating refractory materials including a refractory concrete, insulating firebrick of various ratings up to 3,000 deg. F., and insulating refractory blocks for operating at temperatures up to 2,000 deg. in contact with the flame, or up to 2,200 deg. when used as a backing for some other refractory.

Good quality firebrick weighs on the average 130 lb. per cu.ft. In comparison, the new refractory brick

and blocks weigh from 30 to 37 lb. per cu. ft. Because they are made from the same material as firebrick, their specific heat is the same, but considering their reduction in density, their heat capacity for the same volume of material is of the order of one-quarter that of firebrick. An even better basis of comparison, however, is the heat capacity for such thicknesses of the materials as will give the same insulating effect. Since insulating firebrick can be made with thermal conductivities as low as 1/9 that of firebrick, and refractory block, from 1/9 to 1/12 that of firebrick, the capacity comparison on the equivalent insulation basis is even more favorable to the new materials, as the following shows.

Tests were made recently on a series of small electrically heated furnaces, all identical in outside dimensions and all supplied with electricity at the rate of 7,000 B.t.u. per hour. Among these were the following constructions: (a) walls of refractory concrete made with Insuline; (b), (c) and (d) walls respectively of insulating firebrick rated at 2,200, 2,600 and 3,000 deg. F.; (e) walls of refractory insulating blocks rated at 2,200 deg. F.; and (f) walls of standard first quality firebrick, rated at 3,000 deg. F. Each furnace was raised to a temperature of 2,200 deg. F. and the time to attain this temperature noted. When the results were converted to a comparable basis it was found that the heat capacities for equal insulating effect were approximately as follows: (a) 1/7; (b) 1/25; (c) 1/17; (d) 1/10; and (e) 1/40, as compared with (f), taken as 1. Since these tests were made, a still lighter refractory insulating block has been developed, having a heat capacity of only 1/60 on this basis.

Table I lists comparative properties of this new 1/60 heat capacity insulating block and ordinary firebrick. The same insulating properties are available in a new refractory lagging material. Table II is presented to show the heat flow through various wall thicknesses of insulating firebrick, as compared with ordinary firebrick. This table also shows the exterior wall temperatures that will be found with various furnace temperatures. The curves of Fig. 2 have been prepared to complete the picture given in Table II, namely, to show the quantity of heat that will be stored in insulating firebrick and ordinary firebrick walls at various furnace temperatures, at various intervals after starting the furnace. It should be noted that each curve reaches a steady-state point for each wall thickness shown when thermal equilibrium is attained. Beyond this point no more heat will be stored so long as the furnace temperature is not increased. At this point the wall temperature and heat flow rate as given in Table II will obtain. Each curve was secured in a small electrically heated furnace with the heating element held at the stated furnace temperature.

A consideration of the data in Table II and Fig. 2 will demonstrate the economies to be derived by combining high insulating effect with low heat storage, and make it evident why the latter property of the refractories used in a furnace wall is in many cases equally as important, or even more important, than the former. In an intermittent furnace, heat storage becomes a factor of vital importance. Take for example a furnace 18 x 8 ft. x 9 ft. high, with 22½-in. firebrick walls and a 9-in. roof covered with sand. Such a furnace would weigh 200,000 lb. and would hold, say, 50,000 lb. of a material such as iron. At the same temperature the brickwork would hold twice the heat of the iron per pound; considering, however, the average temperature through the wall, the

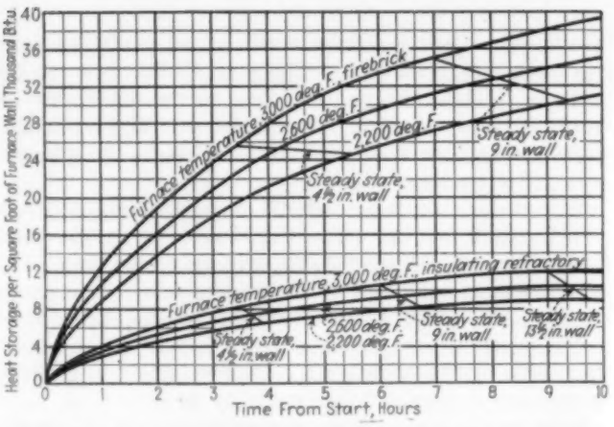

Heat Storage per Square foot of Furnace Wall, Thousand Btu
Time From Start, Hours
Furnace temperature, 3,000 deg. F., firebrick
2,600 deg. F.
2,200 deg. F.
Steady state, 9 in. wall
Steady state, 4½ in. wall
Furnace temperature, 3,000 deg. F., insulating refractory
Steady state, 4½ in. wall
2,600 deg. F.
2,200 deg. F.
Steady state, 9 in. wall
Steady state, 13½ in. wall

Fig. 2—Heat stored in firebrick and insulating firebrick walls at various furnace temperatures; note steady-state lines where radiation rate of Table II is reached

refractories would require approximately the same amount of heat, pound for pound. Therefore, in the furnace, four times as much heat would be used in heating up the walls as in heating the iron, and this heat would be lost when the furnace was cooled after completion of the heating cycle.

Suppose, however, that the same insulating effect were obtained by building the walls of 4½ in. of firebrick, backed up by 1½ in. of the insulating block described in Table I. Such a furnace would be less in weight by 78 per cent, and the heat storage would be reduced correspondingly. The total quantity of refractories plus iron would be decreased from 250,000 lb. to 93,000 lb. and the heating and cooling time would be reduced in the same proportion. Or, the furnace might mave been built for greater insulating effect, in which case it would have less radiation loss than the furnace just described, but a greater heat storage loss. For every particular case an economic balance can readily be calculated, showing just what wall thickness will give the best overall economy for the installation.

Table I—Properties of Insulating Block and Firebrick

	Insulating Block and Lagging	Firebrick
Heat conductivity at		
500 deg. F.*	0.56	.....
1,000 deg. F.*	0.70	8.15
1,500 deg. F.*	0.84	9.99
2,000 deg. F.*	.....	11.95
Service temperature, deg. F.	2,000	2,800
Weight, lb. per cu. ft.	30	130
Heat storage, B.t.u./lb./deg. F.	0.24	0.24
Relative heat storage, for same insulating effect	1/60	1

*B.t.u./sq. ft./in./deg. F./hr. at mean temperatures noted.

Table II—Inside and Outside Wall Temperatures and Heat Flow Through Walls at Thermal Equilibrium

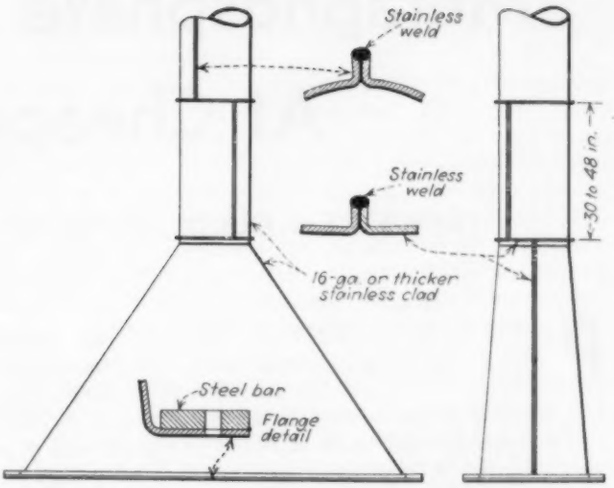
(Based on air at 80 deg. F.; accuracy ± 2 per cent.)

	4½-in. Wall				9-in. Wall			
Inside Furnace Temp. Deg. F.	Insulating Brick		Firebrick		Insulating Brick		Firebrick	
	Outside Deg. F.	B.t.u. Loss	Outside Deg. F.	B.t.u. Loss	Outside Deg. F.	B.t.u. Loss	Outside Deg. F.	B.t.u. Loss
3,000	430	1,230	830	5,350	310	645	600	2,630
2,800	410	1,120	784	4,580	297	600	572	2,360
2,600	390	1,015	738	3,975	284	555	544	2,120
2,400	370	915	692	3,480	271	505	516	1,880
2,200	350	815	646	3,050	258	460	488	1,660
2,000	330	730	600	2,630	245	415	460	1,450
1,800	310	645	554	2,220	230	370	430	1,250
1,600	285	560	508	1,820	215	325	400	1,065
1,400	260	473	462	1,470	200	280	365	880
1,200	235	390	416	1,170	185	235	330	730
1,000	210	310	370	915	170	190	295	580

Stainless-Clad Construction for Tanks And Ducts

AVAILABILITY in recent years of various sorts of ply metals has brought about a new technique in equipment fabrication. A ply metal consists of a relatively thin layer of a corrosion-resisting material such as stainless steel, bonded by a welding process to a thicker backing of a cheaper metal, such as mild steel. The object in applying a ply metal is to fabricate the equipment so that an unbroken layer of the corrosion-resisting material is presented to the action of the process materials. It is therefore necessary to avoid exposing any of the backing metal in the interior of the equipment.

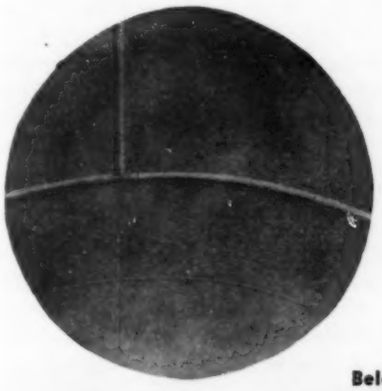
The methods for accomplishing this desirable result are now well understood. The accompanying information, which has been made available by the Ingersoll Steel & Disc Division of Borg-Warner Corp., is based on several years' experience in fabrication of equipment from this company's stainless-clad steel. For example, in recent years, hundreds of vent stacks have been fabricated from 16-ga. IngAclad for use on soap kettles. The same metal has been used to a considerable extent in lining large storage tanks, vats, hoppers and soap kettles, providing an economical method of reclaiming such equipment when it has become corroded.



Fume hood and stack showing method of flanging and welding stainless-clad steel

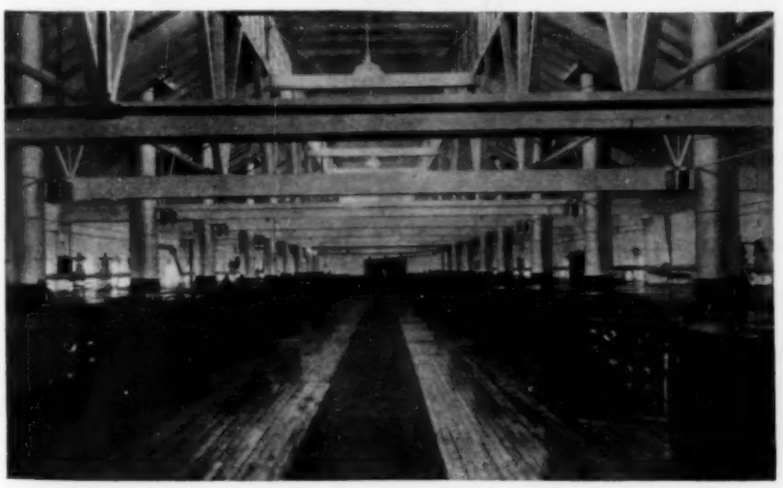
For the fabrication of pipe, stacks and ducts, a technique has been worked out which insures complete stainless steel protection for the interior, yet involves nothing difficult in construction. The ply metal generally used is of 16 ga. and consists of a 20 per cent layer of 18-8 chrome-nickel steel welded to a base of mild steel. As shown in the accompanying drawing, the sheets are prepared by flanging all edges outward. When formed or rolled into a section of piping there is, therefore, a peripheral or circumferential flange at each end of the section and a longitudinal flanged seam running the length of the section. As clad steel is easily worked, the straight flanges may be formed over a bar, or on an apron forming or press brake. Round piping may be flanged over a ring jig. All joints are then welded on the projecting flanged edges, using a stainless steel welding rod and either metallic arc or oxyacetylene welding. Welding speeds of 40 to 60 lineal feet per hour may be maintained readily. It is the usual practice to make sections of stacks and ducts in the shop and make final welds in position in the field. Should this be impractical, the sections can be connected by the use of van stone rings, or they may be bolted or riveted together, with gaskets between sections.

Lining existing tanks is hardly more difficult. The sheets are fitted manually to the walls of the tank, being applied in courses around the wall, with each sheet secured to the tank wall by metallic arc welding. All vertical and horizontal seams are then lap welded. When rivets are encountered a clad strip is formed to fit closely over the rivet heads, as is apparent from the upper left view. A similar method of construction may often prove economical in producing linings for new installations.



Left: Section of wall of soap kettle, lined with stainless-clad steel, showing method of covering rivets with a formed strip which is lap welded to the sheets

Below: Installation of soap kettles equipped with stainless-clad fume stacks



Metaphosphate Investigation Aims At Cheaper Fertilizers

By HARRY A. CURTIS, RAYMOND L. COPSON and ARMAND J. ABRAMS

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PHOSPHORUS PENTOXIDE will react directly with a wide range of compounds. This fact appears largely to have escaped the attention of research chemists, judging from the scarcity of references to be found.

The experimental work recorded in the present paper was initiated to investigate the reaction of phosphorus pentoxide with "rock phosphate," in which the mol ratio of CaO to P_2O_5 is somewhat more than three to one, to form calcium metaphosphate, in which the mol ratio is one to one. (The term "rock phosphate" is used to distinguish the amorphous phosphates, such as occur in the deposits in Tennessee and Florida, from the "mineral phosphates" of definite chemical composition, such as fluor-apatite, phosphorite, etc.) Preliminary laboratory tests showed that phosphorus pentoxide did react readily with rock phosphate, at temperatures above 800 deg. C., to form calcium metaphosphate.

At the time the experiments on this reaction were initiated, a review of chemical books and journals yielded almost no information. In the older technical literature, references were found to heating phosphorus pentoxide with various salts [1, 2], cryolite[3], etc., resulting in the production of the corresponding metaphosphates. Lucas and Ewing[4] in 1927 called attention to a method of preparing phosphorus pentafluoride by the direct action of phosphorus pentoxide on calcium fluoride. Britzke and Pestoff[5], in 1929, published the results of experiments on the thermal production of phosphoric acid and concentrated phosphates. Among other things, these investigators studied the use of chalk and of rock phosphate as catalysts for the reaction between water vapor and phosphorus, and observed that the phosphorus compounds produced by this reaction were absorbed by the catalyst mass with formation of calcium metaphosphate. Britzke and Pestoff proposed taking part of the gases from a phosphate smelting blast furnace, adding superheated steam and a limited proportion of air thereto, and passing the gases upward through a tower containing chalk as a catalyst. The desired temperature (550 to 750 deg. C.) in the catalyst was to be maintained through the partial combustion of the gases by the air admitted. The gases leaving the catalyst chamber were free from phosphorus and had a calorific value nearly as great as the blast furnace gas used. The calcium metaphosphate formed was subsequently hydrated to monocalcium orthophosphate.

Search of the United States patent files revealed that the reaction between P_2O_5 and rock phosphate at "glow heat" had been patented.[6] Reference to German patents brought to light a broader patent, obviously by the same inventor. The broader patent[7], issued in Germany in 1930, has not been issued in the United States. One may conjecture that it was filed in the United States and rejected as being an idea and not an invention of a process. At any rate, barring the unlikely possibility that the broader patent is still pending in the United States Patent Office, the German patent stands as a publication.

The Russian publication of 1929 by Britzke and Pestoff was not cited by the United States Patent Examiner against the patent application[6] subsequently filed.

Aside from the references and patents above mentioned, there are a few others which come close to the metaphosphate idea but presumably do not cover it.

Calcium Metaphosphate as a Fertilizer

Of the many metaphosphates which may be prepared by direct action of P_2O_5 on various compounds, calcium metaphosphate is of special interest because of its possible use as a fertilizer. The commercial significance of using P_2O_5 in this way is at once evident, for it permits elimination of the phosphoric acid plant in converting the phosphorus from a phosphate smelting furnace into a phosphatic fertilizer, assuming for the moment that calcium metaphosphate is indeed a fertilizer, i.e., that the P_2O_5 contained is available to growing plants under conditions met in various soils.

At this time it may be well to point out a very fundamental consideration which is often overlooked by those interested in processes yielding phosphatic fertilizers. Taking the cost of washed phosphate at $4 per ton, the cost of P_2O_5 in a rock or sand carrying 33.3 per cent P_2O_5 is obviously $12 per ton. This would be by far the cheapest source of P_2O_5 for agricultural purposes if growing plants could utilize it. Unfortunately, raw phosphate, even when finely ground and mixed with the soil, ordinarily supplies very little "available" phosphate to the growing plants, and it is seldom economical to use it in agriculture.

If phosphoric acid be manufactured from raw phosphate, it is evident that, no matter what process be used, the P_2O_5 in the acid will be more costly than it was in the raw phosphate. Let us say, for the present argument, that the cost of P_2O_5 in 75 per cent phosphoric acid is $60 per ton as compared with $12 per ton in the raw phosphate.

If dicalcium phosphate be made by treating limestone with phosphoric acid, or if any of the ammonium phosphates be made by treating phosphoric acid with ammonia, it is clear that all the P_2O_5 in the finished product comes from acid at a cost of $60 per ton.

If, however, the phosphoric acid be applied to ground

raw phosphate in the proper proportions, the total available P_2O_5 in the product will have come from both the acid and the raw phosphate, approximately two-thirds of it from the acid, and one-third from the raw phosphate, giving a weighted average cost per ton of P_2O_5 in the sources of about $44 as against $60 in the acid alone. It is therefore evident that any process which does not take advantage of the possibility of getting one-third of the final P_2O_5 from the cheapest of all sources is at a great disadvantage.

In the direct treatment of rock phosphate with P_2O_5, the advantage mentioned above is not lost, for in the calcium metaphosphate formed, approximately two-thirds of the P_2O_5 content will have come from the relatively costly P_2O_5 used as such and one-third from the rock.

Laboratory Investigations

When P_2O_5 was volatilized into a stream of dry air and passed upward through a vertical column of rock phosphate fragments heated to 1,100 deg. C., calcium metaphosphate formed on the surface of the phosphate particles. Since the temperature used was above the melting point of calcium metaphosphate, this compound ran out of the lower end of the column and, on cooling, formed a yellowish, translucent glass. The depth of color depends on the iron content of the rock phosphate, the color being that of dark amber with rocks of relatively high iron content.

Although the rock phosphate carried several impurities, these either reacted with P_2O_5 or dissolved, giving a homogeneous slag. A typical analysis of the crude metaphosphate from a Tennessee brown phosphate is: P_2O_5, 64.6; SiO_2, 4.3; CaO, 24.5; R_2O_3, 3.7; and F, 0.2 per cent. It is of interest to note that the fluorine contained in rock phosphate is largely eliminated in the production of calcium metaphosphate.

The mol ratio of P_2O_5 to CaO in the above sample is about 1.04, whereas in calcium metaphosphate this ratio is unity. In many experiments it was observed that the amount of P_2O_5 absorbed was greater than corresponded to metaphosphate. When the proportion of P_2O_5 in the glassy product was increased far beyond the theoretical for calcium metaphosphate, the product was decidedly hygroscopic.

A rough measurement of the relative hygroscopicity of two samples of crude metaphosphate (80 mesh) compared with that of mono-ammonium phosphate, urea, and ammonium nitrate was made by placing the five samples in a thermostat at 35 deg. C., for three weeks in an atmosphere of 65 per cent relative humidity. The following increases in weight were obtained: $NH_4H_2PO_4$, 0.14 per cent; urea, 9.13 per cent; NH_4NO_3, 64.9 per cent; metaphos (P_2O_5/CaO = 1.04), 0.02 per cent; and metaphos (P_2O_5/CaO = 1.56), 43.8 per cent.

These results indicate that if the crude calcium metaphosphate is to be used as a fertilizer, the mol ratio of P_2O_5 to CaO should be held as near unity as possible.

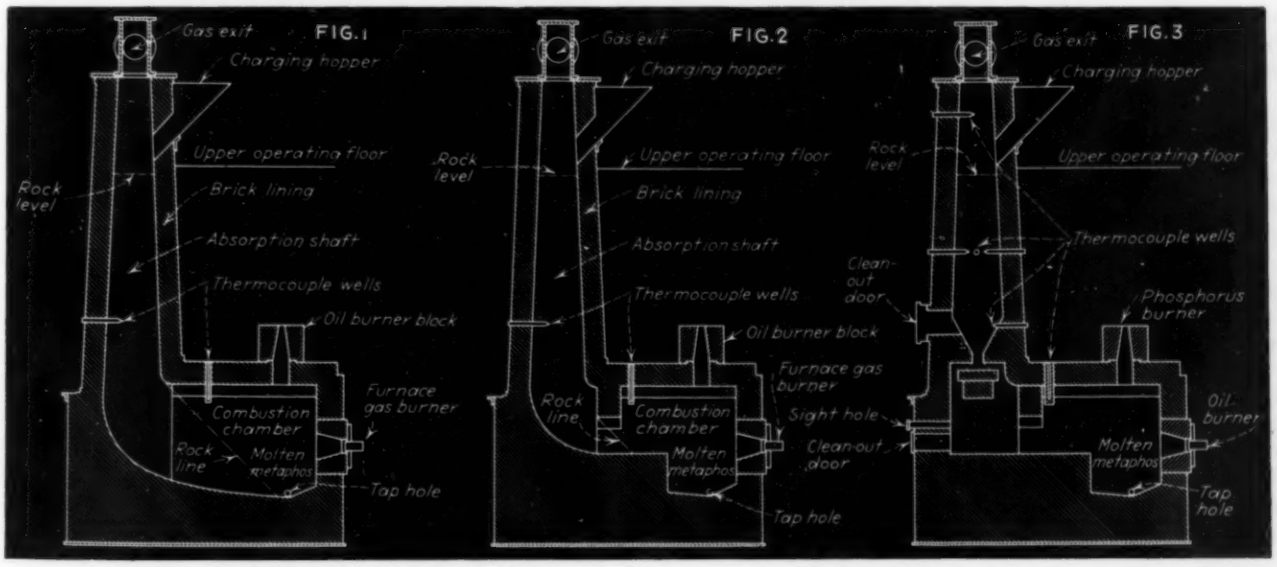
The crude calcium metaphosphates in which the P_2O_5 to CaO mol ratio was approximately unity were water soluble, but dissolved very slowly; so slowly in fact that the glassy product in lump form was stored out-of-doors for a year without appreciable change. This is a fact of considerable interest in considering calcium metaphosphate as a fertilizer, for a large item of cost in any fertilizer plant is the storage building.

In solution, calcium metaphosphate hydrolyzes to monocalcium orthophosphate. The rate of hydrolysis is much increased by adding a little HNO_3 and boiling.

The softening point of a crude calcium metaphosphate having the composition: CaO, 23.7; SiO_2, 7.4; Fe_2O_3, 2.6; Al_2O_3, 4.1; and P_2O_5, 62.6 per cent, made from Tennessee brown rock, was found to be 959 deg. C., using the inclined slide method and heating at 3 deg. C. per minute. This particular sample has a P_2O_5 to CaO mol ratio of 1.147.

From the work done in the chemical laboratory, it appeared that it should be a fairly simple chemical engineering job to develop a furnace in which elementary phosphorus, or the gases from an electric furnace reducing phosphate, could be burned, the hot products of combustion passed upward through a column of rock phosphate and the molten metaphosphate removed at

First, second and final designs of semi-works calcium metaphosphate furnace built by T.V.A.



the foot of the column. As usually happens, the problem did not prove to be quite as simple as it appeared.

A furnace was built as shown in Fig. 1, to use the gases from a 200-kw. phosphate smelting furnace. This furnace produced a calcium metaphosphate carrying lumps of unreacted phosphate, owing to rock sliding into the pool of molten metaphosphate, where further reaction was very much retarded. In order to prevent the rock from sliding into the pool, a shelf and a hanging wall were built in the furnace as shown in Fig. 2. This furnace produced metaphosphate readily enough, but the refractories used at this stage in the development would not stand up in the hanging wall. There was also poor distribution of gases entering the tower.

A checker-work support for the charge of rock in the tower was tried, but here again the refractories used would not withstand the attack of hot P_2O_5.

Air-cooled or water-cooled grates built of stainless steel pipes protected by carbon sleeves were tried. These grates would stand up so long as the temperature of the carbon sleeves was kept low enough. It was difficult to keep the temperature of the carbon low enough to prevent corrosion, without cooling the metaphosphate so that it would not flow through the grate as fast as formed in the tower.

Although the crude calcium metaphosphate formed in this process had a "melting" point below 1,000 deg. C., it was found desirable to carry a temperature at the foot of the absorption tower of at least 1,200 deg. C. At this higher temperature the viscosity of the metaphosphate is lower, the film of metaphosphate surrounding the lumps of rock phosphate is thinner and the rate of reaction faster on the lumps lying just above the grate. These are desirable results so far as the reaction tower is concerned, but the high temperature required makes the problem of refractories a more difficult one. The temperature which can be carried at the foot of the reaction tower cannot be much higher than 1,200 deg. or pyrophosphate will appear in the product.

In all work with the calcium metaphosphate furnace there has been much difficulty in securing good temperature records because of speedy failure of thermocouple wells. In fact, no material has as yet been found suitable for a thermocouple well in the reaction tower. In the top of the phosphorus combustion chamber, a thermocouple well formed of a Corhart cast refractory block has been used successfully.

In all, about 100 tons of crude calcium metaphosphate has been produced in the semi-works furnace. A method of supporting the charge in the reaction tower shown in Fig. 3 has been found to be fairly satisfactory and will be used in the full-scale furnace now under construction.

In all the calcium metaphosphates in which the mol ratio of P_2O_5 to CaO is unity or higher, the P_2O_5 shows 97 to 100 per cent "availability" as measured by the neutral ammonium citrate method. It is, of course, doubtful that this method of measuring "availability" has any meaning when applied to a homogeneous material such as fused calcium metaphosphate. However, calcium metaphosphate prepared by the direct action of P_2O_5 on rock phosphate, is now under test in many agricultural experiment stations and the results to date indicate that the P_2O_5 in this material is in a highly available form.

Other Metaphosphates in the Laboratory

When limestone was treated with P_2O_5 at 1,100 deg. C., a clear glass was obtained. This calcium metaphosphate had essentially the same properties as the less pure product prepared from phosphate rock.

The reaction between P_2O_5 and hot $CaSO_4$ is of special interest in that a mixture of sulphur dioxide, sulphur trioxide and oxygen is evolved, and it would presumably be possible to make sulphuric acid as a byproduct. At 700 deg. C., the mol ratio of SO_3 to SO_2 was found to be 5.9, but condensation of P_2O_5 in the reaction chamber was noted. At 900 deg. C., the mol ratio of SO_3 to SO_2 in the gas evolved was found to be 0.33.

The calcium silicate slag from electric furnaces smelting phosphate rock reacted with P_2O_5 at 1,100 deg. C. to form a metaphosphate of relatively high viscosity at this temperature.

The growing importance of sodium metaphosphate in treatment of boiler feedwater, in laundries, and in washing compounds would appear to make its preparation directly from common salt and P_2O_5 of interest. It was observed that the reaction proceeded readily, but a part of the phosphorus passed out of the reaction chamber as chlorides of phosphorus. The latter reaction probably offers a method of preparing phosphorus chlorides. If the product desired is sodium metaphosphate, however, with no chlorides of phosphorus, the P_2O_5 may be formed by burning phosphorus with sufficient moist air to convert all the P_2O_5 to metaphosphoric acid. The hot metaphosphoric acid acting on the salt yields sodium metaphosphate and hydrochloric acid. The reaction between salt and P_2O_5, with and without moisture, is at present being studied in detail.

Presumably, all halogen compounds of non-volatile bases will react with P_2O_5 or metaphosphoric acid as does sodium chloride. Potassium chloride and calcium chloride have been tried to date.

Metaphosphates have been made from calcium carbonate, sodium carbonate, potassium carbonate, and dolomite.

Calcium sulphate and aluminum sulphate have been converted to the metaphosphates by direct action of P_2O_5, and presumably the reaction is a general one.

Metaphosphates have been made unintentionally by the reaction of P_2O_5 on the refractories used in the various furnaces in which phosphorus and the gases from the phosphate smelting furnaces have been burned. Inasmuch as P_2O_5 forms metaphosphates with all the refractory oxides yet tried, and silica is soluble in the molten metaphosphates, it will be seen that the problem of refractories for a phosphorus combustion furnace is indeed a difficult one.

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7. Ger. Pat. No. 541,178 (June 3, 1930)

Charts for Gas Flow Measurement

By M. C. MOLSTAD and F. B. VARGA

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IN THE COURSE of certain experiments it became necessary to make a number of measurements of the rate of flow of air under such large pressure drops that the simplified orifice formula did not apply. Use was therefore made of the formula derived by Bean, Buckingham and Murphy in Bureau of Standards Research Paper No. 49 (1929). This formula is:

$$w = 0.525\, C_m d^2 \sqrt{\frac{\Delta \rho_m}{1 - \beta^4}} \qquad (1)$$

where w is mass rate of flow of gas in pounds per second; C_m is the discharge coefficient of the orifice based on the mean pressure of the gas (taken as 0.601); d is the orifice diameter in inches; Δ is the pressure drop through the orifice in pounds per square inch; ρ_m is the mean density of the gas, as later defined, in pounds per cubic foot; and β is the ratio of orifice diameter to pipe diameter. (See also Perry's "Chemical Engineers' Handbook," p. 709. The formula is empirical and is based on flow measurements with air at 1 to 13 atm. pressure through concentric square-edged orifices installed in 4, 6 and 8 in. pipes. Even at the critical pressure (p_2/p_1=0.53 for air) its maximum error is not over 2 per cent for air and is presumably equally low for any other gas having no greater deviation from ideality than air.

The mean density of the gas is given by the equation:

$$\rho_m = \frac{M(p_1 + p_2)}{2\,R(460 + t)} \qquad (2)$$

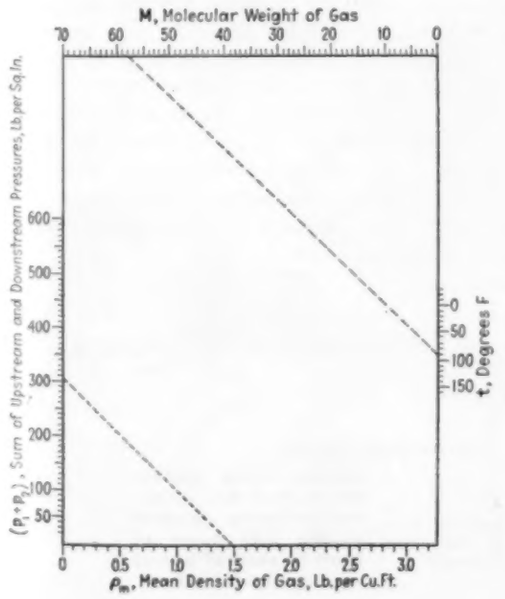
where M is the molecular weight of the gas; p_1 and p_2 are respectively upstream and downstream gas pressures in the pipe, above and below the orifice; R is the gas constant; and t is the gas temperature in degrees F.

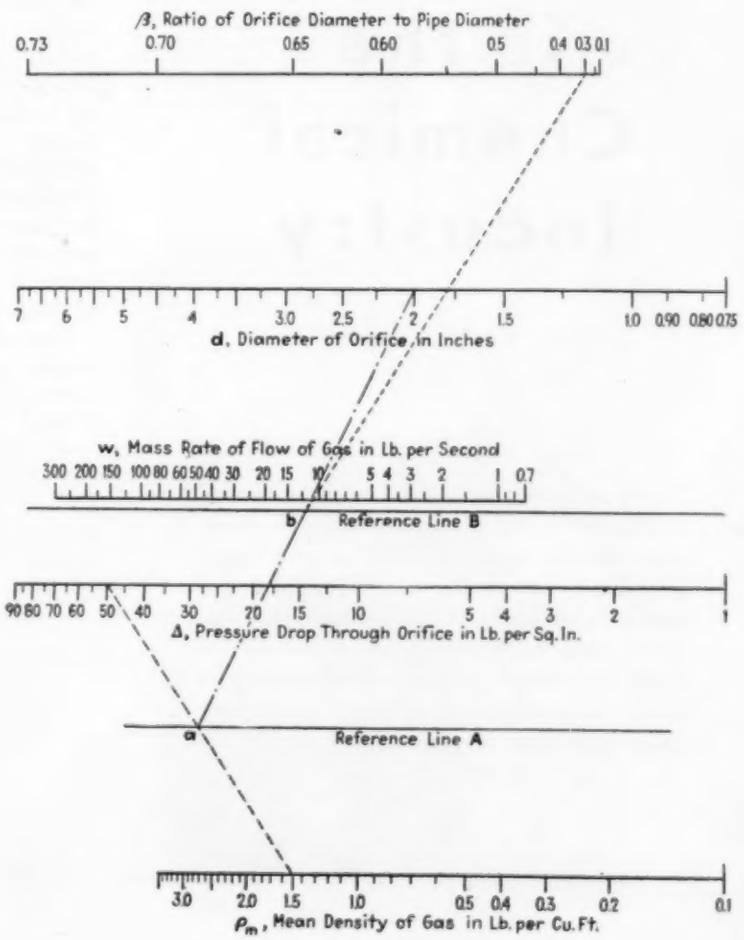
Solution of equations (1) and (2) is greatly simplified by the use of the two nomographs reproduced below. For example, a gas of molecular weight 58 at 90 deg.F. is flowing through a 2 in. orifice with a pressure drop of 50 lb. per sq.in. The sum of the upstream and downstream pressures is 305 lb. abs. per sq.in. The ratio of orifice diameter to pipe diameter is 0.3. What is the flow rate of the gas?

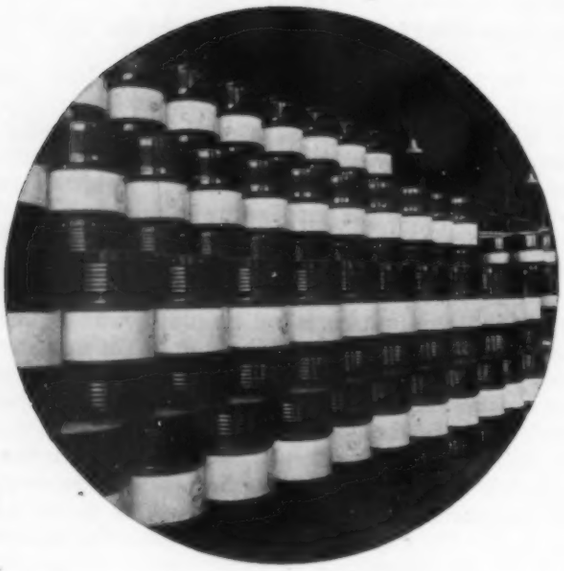
On Fig. 1 connect molecular weight 58 with temperature 90, then draw a parallel line through $p_1 + p_2 = 305$ to intersect the mean density axis at $\rho_m = 1.5$ lb. per cu.ft. On Fig. 2 connect $\rho_m = 1.5$ with pressure drop = 50 lb., intersecting reference line A at a. Connect a with orifice diameter 2 in., intersecting reference line B at b. Connect b with diameter ratio 0.3, intersecting the flow rate axis at 11 lb. of gas per second.

Fig. 1, Below — Chart for determining mean density of gas above and below orifice; note that absolute pressures must be used; density of any gas may be determined by substituting twice the pressure on the gas for sum of pressures on chart

Fig. 2, Right—Nomograph for determining gas flow rate


M, Molecular Weight of Gas
70 60 50 40 30 20 10 0
(p_1+p_2), Sum of Upstream and Downstream Pressures, Lb. per Sq. In.
600 500 400 300 200 100 50
0 50 100 150
t, Degrees F
0 0.5 1.0 1.5 2.0 2.5 3.0
ρ_m, Mean Density of Gas, Lb. per Cu. Ft.


β, Ratio of Orifice Diameter to Pipe Diameter
0.73 0.70 0.65 0.60 0.5 0.4 0.3 0.1
7 6 5 4 3.0 2.5 2 1.5 1.0 0.90 0.80 0.75
d, Diameter of Orifice, in Inches
w, Mass Rate of Flow of Gas in Lb. per Second
300 200 150 100 80 60 50 40 30 20 15 10 7 5 4 3 2 1 0.7
b
Reference Line B
90 80 70 60 50 40 30 20 15 10 5 4 3 2 1
Δ, Pressure Drop Through Orifice in Lb. per Sq. In.
a
Reference Line A
3.0 2.0 1.5 1.0 0.5 0.4 0.3 0.2 0.1
ρ_m, Mean Density of Gas in Lb. per Cu. Ft.



DRUMS in the Chemical Industry

By R. W. LAHEY
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Drums are extremely popular as shipping containers in the chemical, oil and food industries, which employ them for carrying liquid, semi-liquid, powdered, crystalline, lump and solidly fused products. In the past year, approximately 7,000,000 of one type of drum alone have been sold by manufacturers. A drum, the specifications of which are properly chosen will help to promote the sale of the product it carries

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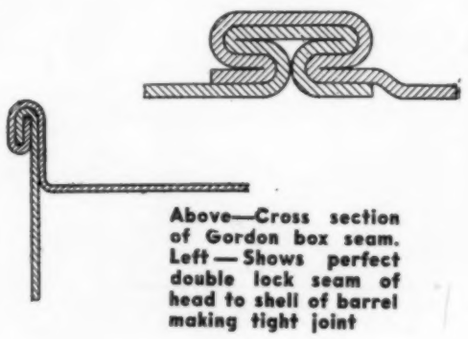
LIGHT GAGE or single trip steel drums are universally used in the process industries. They are general utility containers, tailor made to fit any reasonable amount of product. The use of these containers is widespread—they carry liquid, semi-liquid, powdered, crystalline, lump and solidly fused materials. They are made in a variety of sizes and shapes and their openings include almost every conceivable type.

These containers, of certain special constructions, are authorized for the shipment of many dangerous articles such as flammable liquids, oxidizing materials and poisonous substances. They have a reputation for adequately carrying the goods to market and they have proved safe over a long period of years.

There are two general classifications: (1) those used for transporting dry products, and (2) those used for transporting liquids. They can usually be distinguished by the difference in their openings. All liquid drums have welded side seams while the majority of those used for solids or powders have pressed seams. Those products like pastes, etc., which are classed between solids and liquids are usually packed in welded side seam containers with large openings.

All these containers used in rail shipments should meet the specifications laid down by the Consolidated Freight Classification Committee in Rule 40, Section 5. Single trip steel barrels or drums may be used for shipping solid or dry articles once only, and the rule clearly states that they must not be used as freight containers a second time. The terms "dry" or "solid" are defined as referring only to articles which are dry or solid at a temperature of 100 deg. F. This rule gives the shipper the responsibility of determining the gage of steel to be used for single trip drums. It specifies the minimum gage which can be used for returnable drums. If the article to be packed is dangerous, the Interstate Commerce Commission Regulations for Transportation of Explosives and Other Dangerous Articles supersede the above specifications. There are several different specifications for single trip steel drums carrying hazardous articles depending upon the degree of danger involved.

Drums for solids, lump or powdered materials are usually made with Gordon box, shell or side seams. There are also single lock or hook seams used in some drums, but they are inferior to the former type. The hook seams are made by forming hooks at each edge of the sheets interlocking them, and pressing them together. This construction is sometimes strengthened by spot welding at intervals along the seams. Side seams of drums, made from sheets lighter than 20 gage are now



Above—Cross section of Gordon box seam. Left — Shows perfect double lock seam of head to shell of barrel making tight joint

being welded successfully. This is the strongest side seam and undoubtedly drum manufacturers will gradually adopt it.

Side walls of these drums are often strengthened by expanding corrugations of varying size and number in the bodies after the side seam has been formed.

Head seams are of the double lock or double seam type and are most satisfactory. It will be noted from the drawing of this seam that there are five thicknesses of metal at the chime. The effectiveness of these drums are entirely dependent on the workmanship of the maker. If dies are not maintained in good condition and rolls are not exactly set, the drum metal may not be rolled to form a proper double seam. The metal of both head and shell must be driven home to secure the necessary strength. If at any time the question of a faulty seam arises, it can be quickly answered by cutting out a section of the chime with a hack saw. This will show clearly whether the seam has been properly formed.

It is practically impossible to make drums with pressed side seams that will not leak when filled with water. Although the seams may be painted with a filling compound such as aluminum paint, a certain percentage will leak. On the other hand, the welded side seam drums are water tight. Of course these drums are not filled with liquids, but this is a test which can be used to determine the relative tightness of the containers.

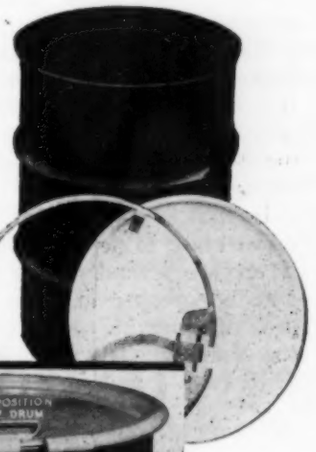
The varieties of openings which have been devised for these containers are too numerous to cover in detail. The most popular types are described below.

1. The friction lid is probably the most commonly used. It is cheap and an effective closure when the bearing surface between the flange of the drum and the cover is sufficient to provide a tight fit. A lid with a depth of $\frac{5}{8}$ in. is adequate. Friction lids are used in openings of from 4 to 15 in.—of course the smaller the opening the stronger the drum and the less likelihood there is that the cover will pop out.

These covers are sometimes fastened in position with three or more turnbuckles. Usually a small hole is drilled in the side near the end. The purpose of this is to wire the turnbuckles in position over the cover so that transportation abuses will not move them. A lead seal can be applied to the wire to assure the user that the container has not been opened.

Covers are also reamed or expanded to hold them in position. If this fastening is desired, the flange of the cover should extend below the flange of the drum head. The expanded cover makes an extremely tight closure but it should be borne in mind that when it has been removed, the cover will not form a tight fit—in fact it is difficult to replace.

2. The bolted cover is another popular type. This opening is principally used in drums holding pastes and other semi-liquids, powdered or lump materials where large openings in the container are desirable. In this case, the bearing surface is between the flat head of the drum and the flange of the cover. There is usually a gasket between them. Nuts are attached to the under side of the head by welding. Machine screws are used to fasten the cover. This makes a tight closure and for large openings is stronger than the friction



Examples of full removable head drums. The ease of emptying this type of container has quickly made it popular. This closure is invariably the customers' choice, but it must be remembered that it will not withstand the same abuse as the small closures

Open top barrel with 15-in. bolted opening

Left — Friction lid held on with four turnbuckles

GASKET PROTECTION. Empty drums shipped with Lever (locked in loose position) providing practically no pressure on gasket.
SHIPPING POSITION OF EMPTY DRUM
LOOSE NOTCH
TAKE OFF POSITION
EASY OPENING. Release lock: pull out Lever.
RING (NOT IN USE) RETAINED ON ROLLING HOOP. Not necessary to lay it aside to be misplaced or damaged.
RING RESTING ON FIRST ROLLING HOOP - LEVER ALMOST CLOSED

cover. There are of course several minor variations of this opening devised to serve special conditions.

3. The full removable head is rapidly assuming a position of importance in the drum closure field. The ease of emptying this container has quickly made it popular. The head is formed to fit as closely as possible on a curled drum chime. A gasket is fastened to the head to bear on the rounded chime. The head is held with a ring which can be drawn tight with a lever or bolt. Many different devices have been used, a few of which are illustrated. The heads are sometimes made of heavier metal than the rest of the drum and this usually applies to the ring as well. This closure is invariably the customers' choice, but it must be remembered that it will not withstand the same abuse as the smaller closures.

4. The screw lid is a popular closure for carbide drums. The effectiveness of the seal naturally is limited as threads cannot be efficiently pressed into metal of the gages in question. There is a gasket on the flange of the cover and the bearing surface is between the drum head and the cover flange, depending on tight screwing for pressure. The lid has a fin to provide ease in tightening.

5. The lug cover drum is in demand for certain purposes. A sealing tool crimps the lugs under the curled portion of the head. The user must pry out each lug with a screw driver to open the drum.

There are so many types of closures in use that it is impossible to describe them here. Two examples are the regular friction cap with an internal expanding ring fitted into the depressed portion of the lid, and the head held by an internal ring which locks without fittings.

In the choice of a drum opening, the shipper has an opportunity to perform a real service to his customers. There are several factors to be considered, such as the ease of opening and the necessity for re-sealing, the ease of emptying and the ability to completely reclaim the contents. The flange in the opening extends downward from ¼ to 1 in. and this prevents complete dumping. This difficulty is often lessened by locating the opening off center and as close to the chime as possible. The manner in which the customer uses the product is the guiding factor in this choice and the shipper can create in the mind of the user a feeling of irritation at the product when the drum opening is not designed for his convenience or he can create a feeling of friendliness by making his customers' job as easy as possible.

There are great possibilities for the chemical shipper to improve the appearance of his drums by proper choice of painting, printing, lithographing and even embossing. Only in the last few years have a few companies considered it desirable to see that their drums carried to the minds of their customers, the fact that their drums are neat, clean and bear an attractive trade mark. Oil, alcohol and food producers have led the way and they are now marketing products in attractive packages. This movement is gathering momentum and it behooves all shippers to give the question careful consideration.

There are certain facts which should be considered in designing a light gage drum. The physical characteristics of the product have a direct bearing on the gage of the steel to be chosen. A dry product which is packed in a molten state and then solidifies, forming a support to the drum metal can safely be shipped in drums made of 28 gage steel—even as much as 350 lb. to the drum, whereas this quantity of a powdered, lump or granular product would hardly be satisfactory. Shape and size must also be considered. Although they may carry the same weight smaller sizes are more durable than the larger ones.

It is difficult to recommend any definite weight of metal to carry certain load limits. Conditions of transportation vary so that each shipper has to size up his own requirements and pick an adequate construction. As an

Full removable heads are assuming a position of importance in the drum closure field. The head is formed to fit as closely as possible on a curled drum chime. The head is held with a ring which can be drawn tight with a lever or bolt. Many different devices have been used, a few are shown here

indication of this reference to the single trip Container Specifications for Dangerous Articles shows how great the variation is. Note specification 6D, 6E, 6F and 6G. The weight limit of 880 lb. is variously specified in from 18 to 24 gage drums.

It is always wise to make a periodic check-up on the details of construction of these containers. From time to time new closures are developed, new seams devised, and improved methods of decorating discovered. Containers which incorporate such changes as they are placed on the market, clearly indicate the alert wide-awake attitude of shippers and their readiness to adopt improvements.

There are many shacks and roofs of buildings made from galvanized sheets in Africa and other countries which started their existence as light gage drums.

Drums for Liquids

Liquid drums of the light gage variety vary in capacity from 5 to over 55 gal. Of all the drums used in industry the 18 gage 55 gal. type are the most important. In the last 12 months, approximately 7,000,000 of these containers have been sold by manufacturers. The most important users are the oil, chemical and food industries. These drums are an outstanding example of a standard container in a field that to date has largely been unable to standardize their packages.

Some years ago through the efforts of the Steel Barrels and Drums Committee of the Manufacturing Chemists' Association and the Draper Manufacturing Co. this type of drum known as the 5E was approved by the Interstate Commerce Commission for single shipments of inflammable liquids flashing above 20 deg. F. (open cup). This proved to be a wonderful opportunity for these containers and they took full advantage of it. The alcohol and oil industries quickly adopted them and they rapidly became extremely popular. They have an outstanding record of achievement in transportation. To back this up, recent tests for the M.C.A. conducted by D. G. Stewart of E. I. du Pont de Nemours & Co. to determine the efficiency of crowned heads indicate the capacity of these containers to absorb rough treatment. A more severe test was recently made for the M.C.A. by Stewart. The attending pictures show the drums after testing.

Small light gage container with 8-inch screw cap with grip handle. Below—The lug cover drum is popular for certain purposes. A sealing tool crimps the lugs under the curled portion of the head

Any liquid shipped by rail and packed in drums should meet the specifications of the Consolidated Freight Classification Committee, Rule 40, section 5. It will be noted that the use of these drums is not limited to a single trip. If the liquid is dangerous as defined by the Regulations for the Transportation of Explosives and Other Dangerous Articles, then Rule 40 is superseded by these latter regulations. The single trip drums are known as I. C. C. Specification 5E and 5J. The specifications of the Consolidated Freight Classification Committee merely state that the drums must be made of specified gage metals for certain sizes, whereas the single trip drums for dangerous materials must be able to withstand certain definite tests, such as hydrostatic, internal air and drop. The specifications are in detail as to gage of metal, convexity of head, marking, etc.

The I. C. C. 5E drum is of 18 gage for the 55 gal. size and is chiefly used for the shipment of inflammable liquids flashing above 20 deg. F. The record of this drum has been so good that recently the I. C. C. approved a request of the M. C. A. to add a single trip container, I. C. C. 5J, to the approved list for inflammable liquids without limitation of flash point, although a few extremely dangerous liquids have not been authorized for shipment in this latter container.

The 5J drum, in the 55 gal. size, is of 16 gage throughout and must withstand a greater hydrostatic test. This further extends the field of the single-trip container in the dangerous article classification.

These drums are usually manufactured from steel sheets made by the continuous rolling mill process, the advantages of which were enumerated in an earlier article (*Chem. & Met. Eng. vol.* 43, *p.* 28, 1936). After re-squaring, the fittings in the body sheets are stamped in. The sheets are then formed into cylindrical shapes and welded. The rolling hoops and reinforcing corrugations are expanded or rolled in and the ends flanged to prepare for the double seaming of the heads. Some manufacturers reroll the rolling hoops which broaden them. They claim that they are thereby made stronger. These expanded corrugations and hoops sometimes cause breaks at the weld requiring gas weld repairs which tend to mar the appearance of the drum.

Heads are die cut and the edges shaped to fit into the double seaming operation. The mechanical head flanges are pressed in and they are ready to be applied to the body. The double seaming operation is one of the most important factors in the fabrication of a drum. The rolls must be in perfect condition and set exactly in order to make perfect seams. If the metal is

Drums are given a drop test in this type of apparatus. For effect this test has on drums see illustrations on opposite page

Attention Users of Drums!

Ten practical problems in the construction, filling, packing and shipping of drums will be discussed at the First Bulk Packaging Conference of the American Management Association to be held at the Hotel Pennsylvania in New York on Wednesday, March 24. For the first time in history, chemical manufacturers will thus have an opportunity to check experience with that of other shippers—to learn of new developments vitally affecting their present practice and procedure. Plan now to attend or to send a representative! For those who can not participate in this Bulk Packaging Conference, a full report by Mr. Lahey will appear in these pages next month—Editor

Each manufacturer has his own opinion of what type of tests are required. Probably all conduct an air test with the drum submerged in water

Center—Testing welded seams for leaks. Right—Head seams are tested for leaks. If leaks are detected they are usually pin holes in the weld or double seam and can be closed by acetylene welding, providing the holes are not too large

not driven home properly there is a weak spot in the container.

The drum is then ready for testing and decorating. Each manufacturer has his own opinion of what type of tests are required. Probably all conduct an air test with the drum submerged in water. If leaks are detected they are usually pin holes in the weld or double seam and can be closed by acetylene welding, providing the holes are not too large.

The head seams of drums are lined with a plastic material in order to close any possible cracks left by the bending of the two metals. The material commonly used for this purpose is animal glue. This is a point that the drum user should consider as some liquids are solvents of animal glue. In instances such as this, the real danger of leakage occurs when a drum has been dropped on the chime in such a manner that there is a tendency for the seam to open. The liquid has free access to the lining material and if it dissolves it, the liquid may find its way around the metal and a leak results. There are several lining materials available and the user has a rather wide choice.

Openings in the 18 gage drums are generally of the pressed in variety. The spud is pressed into the drum sheet by various methods. A rubber or asbestos gasket is used to completely seal the joint. The plug is the ordinary screw thread type and there is usually a rubber or asbestos gasket used. Three and one-half to five threads engage depending on the type of fittings chosen. In the last few years a cap seal has become quite popular as it is tamper proof and affords an additional seal. This has required the recessing of the plug in order to accommodate the seal.

The principal factors in choosing fittings are: (1) Effectiveness of seal, and in this connection the action of the product to be packed on the gaskets in both the plug and spud should be determined. (2) Ability to obtain complete reclamation of contents—any extension

of spud into interior of drum will prevent complete drainage unless ports at the level of the drum sheet are drilled into the spud. (3) Spuds should be securely attached to drum sheets so they do not turn in the drum when excessive pressure is required to release the plug. (4) Plug should be so formed that it can be removed with ordinary tools. This last point is one which requires standardization, as it is now necessary to contend with a great variety of shapes and types of plugs, requiring quite a few tools to remove them. Some steps should be taken to correct this.

In recent years the demand for purer materials has increased tremendously. The plain steel interiors of drums have always been a possible source of contamination which had to be eliminated. Steel free from scale and rust has been demanded and obtained by drum manufacturers. In addition, drums are lined with various types of lacquers to prevent corrosion and this has also improved conditions.

The development of special linings for steel drums has opened additional outlets for these containers. Nitrocellulose cotton wet with alcohol and certain liquids can now be packed in these specially lined drums without danger of contamination from steel. The drum manufacturers, not understanding the problems of industry, have made the mistake of attempting to use a lining which was developed for a specific purpose to solve any and all contamination difficulties. This of course has caused many failures, due to solvent action of different materials on the linings. They have learned from this experience and they are now treating each product as a separate and distinct problem, testing all existing linings and if they do not resist the material, attempting to develop a new lining.

Any lining which is applied by spray, brush or other method must form a complete coating. Many have failed, due to inability to apply without leaving small pin holes but this has been largely overcome by the application of a second coat which covers holes in the first.

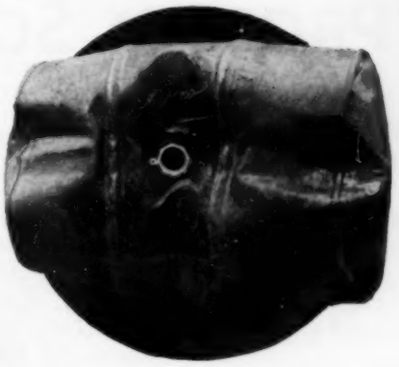
The importance of attractive decorations for drums containing dry products was referred to previously. Drums are painted, using two and sometimes three colors if desired. In addition to painting, the sides can be printed, using rubber plates. The heads can be lithographed with lead plates. Finally, the drums are sometimes embossed, showing the serial numbers, the trade mark and the manufacturer's name. The warning labels required for dangerous articles are sometimes printed on the drums to obviate the necessity of pasting labels and to assure against loss.

It is a difficult problem to get these drums into the users hands without marring the decorations, and both the drum manufacturer and the maker of the product have had to use a great deal of care and ingenuity. Some drum manufacturers cover each drum with a creped paper bag, similar to the loose paper liners used in textile bags while others use extreme care in loading to prevent chafing in transit.

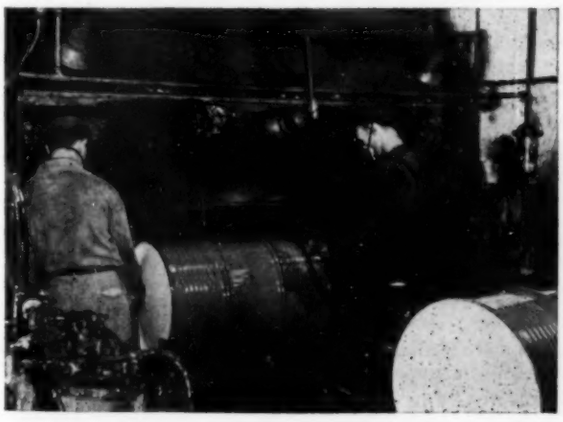
Although these containers have an enviable history for freedom from failures in transportation, they are sometimes abused. As much as 600 to more than 800 lb. of extremely heavy paints and other chemicals can be packed in 55 gal. drums. The containers are then at the danger limits and failure may result if they are abused. The recommended limit is between 550 and 600 lb., although there is a greater factor of safety if the crowned head or 5E drums are used.

Most shippers have the opinion that any type of 55 gal. I. C. C. 5E drum is a good shipping container. This is in general true, but a careful consideration of details will result in a container that is much better than the average. There are such specification details as choice of fittings, use of cap seals, head lining compounds, rolling hoops and convex heads which when properly chosen provide outstanding containers. Economy is a secondary consideration, but a drum, the specifications of which are properly chosen, will help to promote the sale of the product it carries.

These drums were dropped at least once from a height of 4 ft. onto the steel rail shown at top of opposite page

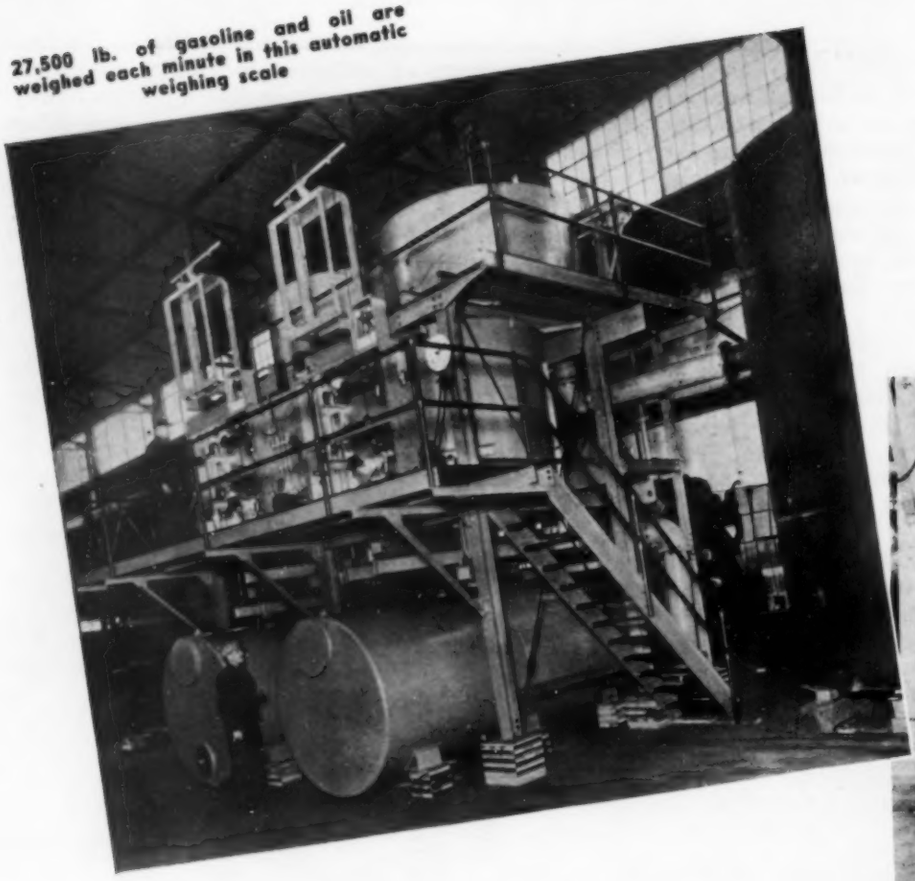


This drum was dropped three times from a distance of 6 ft.

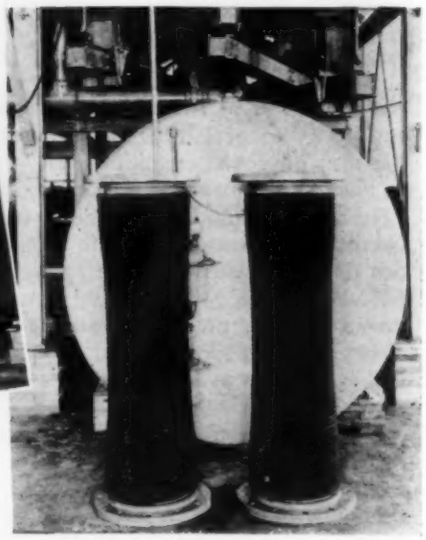


Drums are painted using two or three colors. In addition to painting, the sides can be printed, using rubber plates

27,500 lb. of gasoline and oil are weighed each minute in this automatic weighing scale



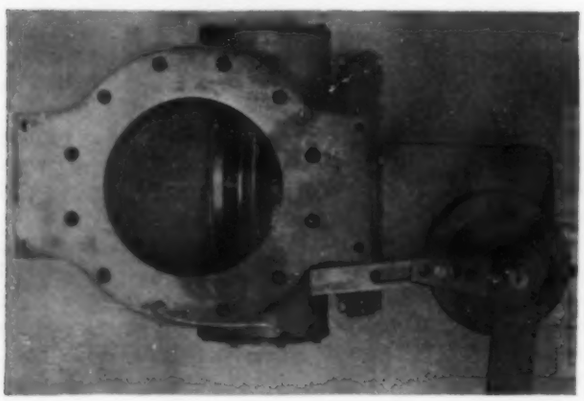
The manufacturer was confronted with the problem of obtaining 12-in. hose which would be flexible as well as gasoline proof



WEIGHING PROBLEM SOLVED

WHAT is said to be the world's largest automatic liquid weighing scale was recently delivered to the Cuban Government for measuring cargoes of oil and gasoline, to provide a more accurate basis for the levying of import duties by that Government. Satisfactory operation of this scale depends upon the oil-proof character and the flexibility of vital rubber parts. Using Thiokol synthetic rubber, the manufacturer was able to give an unconditional oil-proof guarantee on those parts. Of particular engineering interest is the use of this same plastic material for hose and valve seat disks.

Gasoline-proof synthetic rubber valve seat disks were designed to permit and insure instantaneous stoppage of liquid flow



Cuba's big scale weighs 27,500 lb. of gasoline and oil each minute. To convey and weigh this amount accurately, the manufacturer was confronted with the problem of obtaining 12 in. hose which was exceedingly flexible as well as gasoline proof, as the liquids are conveyed from a feed pipe to two large floating tanks, and any resistance to the delicate movement of the weighing tanks mounted on scale levers, would seriously affect the accuracy of the scale. For the same reasons, leakless gasoline-proof rubber valve seat disks were designed and manufactured of Thiokol to permit and insure instantaneous stoppage of the liquid flow at exactly the proper moment.

Tests made at the ceremony at which the Cuban Government formally accepted the scale, revealed that the scale registered an error of less than 1/900 of 1 per cent.

The scale was manufactured by the Richardson Scale Co., and all Thiokol parts were produced by the Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc.

Chemical Engineering Problems In the Paper Industry

EDITORIAL STAFF REPORT

THE ANNUAL MEETING of the Technical Association of the Pulp and Paper Industry was held in New York, February 22-25. Approximately 700 members attended, which is a much larger attendance than ever before recorded.

The Association Medal was presented to C. J. West of the Institute of Paper Chemistry, Appleton, Wis., for his services to the industry. As Harry F. Lewis, dean of the Institute, said when presenting the medal to Mr. West, "He has added greatly to the literature of paper making by the publication of two large volumes of 'Bibliography of Paper Making' covering the period 1900-1935." He is the author of over 500 books, translations, etc., nearly all of which concern the pulp and paper industry.

The following officers were elected to serve for another year: G. N. Collins, president; W. R. Maull, vice-president; and R. G. Macdonald, secretary and treasurer. W. M. Shoemaker and John Traiquair were elected members of the executive committee to serve for three years.

The number of engineering papers presented was unusually large. A few of those papers of most general interest will be referred to here.

Since the introduction of alloy steel for sulphite service about 1929, practically all mills have been entirely or in part equipped with this material for handling hot acid and gas, according to J. M. Miller, chairman of the materials of construction committee. Mill experience in the intervening years has shown that the success of alloy steel depends on the analysis of the steel, the quality of the product as fabricated, and the avoidance of galvanic action in the mill installation.

Materials of Construction

The Committee has been interested in the problem of corrosion and it was considered desirable to survey mill experience. A questionnaire was sent to the sulphite mills with inquiries covering alloy steels and other materials, which might be in use, together with a few related questions of general interest.

One of the findings is that one mill in every six had gone 100 per cent from non-ferrous alloys to alloy steels. As a general proposition it is assumed that economies should result from the use of the more corrosion resistant material, and it was found that maintenance was reduced from as little as two cents to as much as thirty cents per ton of pulp. The average saving was nineteen cents per ton. Mr. Miller draws the conclusion that a definite step is shown in the elimination of non-ferrous alloys in the sulphite mills.

The maintenance of equipment with the assistance of metals sprayed into the parts was described by R. A. Axline, president of the Metallizing Engineering Corp. Although this process was in use prior to the War, it has only found widespread acceptance and use in the last five years, according to the author. For this reason, it is not uncommon to find engineers who are either not familiar with the process, or if they are acquainted with it generally have no understanding of the rapid advancements that have been made in its use, nor do they have a clear picture of the practical work which can be done with the process in their industry. Today modern metal spray equipment deposits approximately 6 lb. per hr. at a deposited cost per lb. of $1.12.

In paper mills, metallizing equipment is used primarily for maintenance work of two types: first, of worn or defective mechanical parts, ranging from the smallest pump shaft to the largest size rolls, and second, the application of corrosion resistant coatings to various types of equipment where corrosion has heretofore been a severe problem.

Kraft Mill Developments

Recent kraft mill developments were discussed by D. G. Moon, chief engineer, Union Bag and Paper Corp., Savannah, Ga. Referring more particularly to the pulp mill, the main objective has been directed to more efficient recovery of chemicals and heat, development of automatic control and reduction of odors. The major improvements will be found generally to apply to:

1. Controlled cooling methods with applications of circulating systems, and indirect heating with return of condensate to the boilers.
2. Recovery of heat from blow-off steam and relief gases to give hot water for washing pulp and general mill use.
3. Use of highly efficient evaporator units with additional effects for higher concentrations.
4. Recovery furnace units with water cooled walls giving efficient reduction of smelt and generation of steam at high pressure from the concentrated liquors.
5. Continuous causticizing systems and lime recovery.
6. Reduction of odors, by condensing the blow-off steam and relief from the digestors and collection of vapors from other sources for elimination in the boiler furnaces.

While much has been done in the application of special alloys to counteract corrosion in the pulp mill equipment, further research is believed necessary to develop direct causes, which in many cases have not been determined definitely as to origin, whether abrasive, erosive, electrolytic hot wall action or direct corrosion.

The use of full automatic controls in manufacturing and operating is becoming more and more in general favor. It is a wonder sometimes, however, that the operator does not lay down in despair when he first sees the multitude of valves, controls, gages and gadgets that he is expected to supervise, as Mr. Moon stated. The success of modernization is a joint responsibility resting in the ability of the technical man to convey to the practical operator the principles involved and last, but not least, is the ability of the technical man to learn and obtain ideas from the operator.

Flow Properties of Suspensions

The flow properties of dilute suspensions of clay and other minerals were discussed by R. N. Traxler, of the Barber Asphalt Co. The various types of flow encountered in dispersed systems containing various concentrations of solid were described and likewise the instruments for evaluating flow properties in such systems.

It was pointed out that particle size, size distribution, and shape are primary properties of the particles of a mineral filler, and that dependent on these are the secondary properties of the compacted powder such as per cent voids and average void size. The methods for determining both primary and secondary properties were covered briefly.

A simple relationship has been established between volume concentration of the solid present and the viscosity of the suspension. This relationship makes possible an accurate evaluation of the influence of a dispersed solid on the flow properties of slurries of which it is a part.

A pulp or paper mill uses more water than any other one material; in other words, it is one of the raw materials of the industry, yet how seldom is it so considered, as Hervey J. Skinner, president of Skinner & Sherman, Inc., emphasized in his paper dealing with the significance of water. If the pulp or paper mill operator could fix this fact in his mind and realize the importance of giving it the same consideration that he gives to other raw materials, many troubles could be avoided or at least minimized.

The objectionable impurities of water such as color, suspended matter, iron, manganese, and hardness were discussed together with methods for their removal. The necessity of water softening for boiler purposes and sometimes for making up size solutions was pointed out and a brief comparison of softening by the soda-lime process and the zeolite process was made. Chlorination for slime prevention and corrective treatment for corrosive waters was also touched upon.

Every plant operating any process of a chemical nature should have a chemical engineer in its staff or as a consultant. It is well known that there are many manufacturers who have made money in the past but who are unable to do so under present competitive conditions. In a number of instances this is due to the fact that fine points of operation have been neglected, among which may be mentioned the proper treatment and utilization of their water supply. The successful manufacturer of today insures the continuation of profitable operation by instituting technical control under the supervision of a competent chemical engineer.

In a paper on water purification to meet paper mill requirements, A. S. Behrman, chemical director of the International Filter Co., also stressed the fact that the pulp and paper industry is not always sufficiently "water minded." The author stated that a fairer criticism might be that a part of the industry does not realize that the process of water purification has not stood still, but has progressed by leaps and bounds, especially in the last ten years, making possible new standards of purity and quality not previously attainable. Many of the methods followed and water purification plants still utilized by some of the older mills are so obsolete that they simply can not meet present-day requirements with the economy, efficiency and uniformity of modern methods and equipment.

The item of cost is always one of interest and importance. The cost of chemicals for coagulation and color removal will usually range from a minimum of about ¼ up to a maximum of about 2 cents per thousand gallons. Where water softening is required, the cost of chemicals will vary, of course, in proportion to the hardness of the raw water. Bearing in mind both the suggested standards given in the paper by Dr. H. C. Schwalbe at the same meeting, as well as the character of the water supplies most likely to be encountered, the cost of chemicals for water softening will range for the most part from about 1.5 to 5 cents per thousand gallons.

Modernization

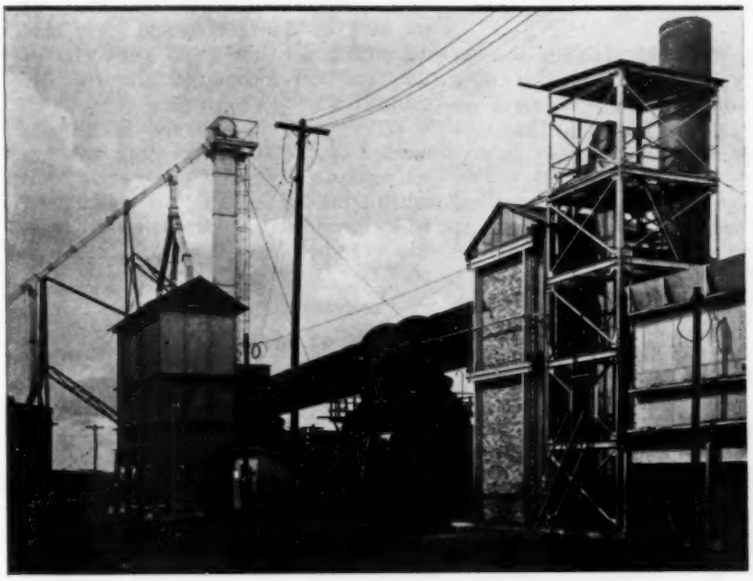
Many of the older paper mills have now reached a point in their existence when they are confronted with greatly reduced profits, Frederic C. Clark stated in his discussion of the problem of paper mill modernization. Some are operating at substantial losses. The past five years has seen some of these mills go out of existence which were formerly highly profitable. Managements of these unprofitable mills are confronted with a serious problem both to their stockholders as well as to the communities that depend upon them. Can these unprofitable mills be rehabilitated? That is the question that must be answered.

The answer to this question can only be made as a result of a thorough study of each individual plant, its general layout, equipment, personnel, and sales policy. All of these points must be carefully studied and analyzed in their relationship one to the other. Management is sometimes too close to its own picture to see more than details and fails to see the picture as a whole. Again management may have lost that intimate contact with its business and as a result may not realize how far it is behind its competitors in manufacturing details. All of this makes it difficult for management to prepare a plan because it is unfamiliar with cost estimating for mechanical changes that may be required.

The making of a mill survey for rehabilitation purposes requires a knowledge of plant engineering and engineering cost estimating. It requires a thorough knowledge of operating procedure and ability to determine what each operating unit is capable of producing.

CALCINING PETROLEUM COKE

By J. C. WATKINS
Port Arthur, Texas



Calcining furnace at the plant of the Great Lakes Coal and Coke Co., Port Arthur, Tex., where petroleum coke is processed

A NEW PLANT, one of two of its kind in the world, has been put into operation at Port Arthur, Texas, by the Great Lakes Coal & Coke Co. to convert petroleum coke into almost pure carbon and in a form suitable for many industrial uses.

Petroleum coke is a byproduct produced in the refining of oil in certain types of stills. Before screening, in the form of still run or pile run, it somewhat resembles both bituminous mine run coal and oven run byproduct coke. Its outstanding characteristics are low ash (generally under 0.50 per cent) and extremely high thermal value (approximately 16,000 B.t.u. per lb.).

Mountainous storage piles of petroleum coke, amounting to several millions of tons, accumulated at Texas and adjacent coastal and interior refineries, as well as at other refineries located throughout the United States. As a result of the lack of market the problem of storage became an acute one at many refineries, creating an expense for handling coke into storage, taking up valuable storage space within the refinery sites, as well as adding to the fire hazards around the refineries.

In 1932, the Great Lakes Coal & Coke Co. entered into an arrangement with practically all of the refiners to concentrate its efforts on creating a market. This involved construction of large plants for cleaning, sizing and screening the coke, transferring it into railroad cars or vessels or barges at ports of loading and similar terminal facilities at numerous ports of discharge. These efforts resulted in completely liquidating the storage piles of what was a burdensome and practically valueless product. In searching out the possible uses for petroleum coke, it was found that certain foreign and domestic consumers required for metallurgical purposes a material having the highest possible content of pure fixed carbon. They required such a material in the manufacture of carbon electrodes, particularly for the aluminum industry, carbon brushes for electric motors, for crucibles, for dry cells, abrasives, and many other miscellaneous uses.

To meet this demand Great Lakes Coal & Coke Co. installed a unique plant (there being only one other of similar construction in the world) using the raw petroleum coke as its basic raw material. Carefully selected petroleum coke is taken direct from the refinery stills, of which there is a concentration at Port Arthur, where it is either placed in storage that has been carefully planked to avoid any possible contamination or is charged directly into the heating equipment where it is subjected to temperatures of approximately 2,700 deg. F. It is then cooled and placed in dry storage sheds.

The operation is known as calcining and the finished product is calcined petroleum coke. It is sold to metallurgical consumers throughout the world under very rigid specifications and analytical guarantees.

A typical analysis of this material is as follows: ash, 0.35 per cent; volatile, 0.39; fixed carbon, 99.26; soluble salts, 0.11; sulphur, 0.64; silicon, 0.09; and iron, 0.06. Its real density is 2.08. As an indication of the care taken to guarantee the purity of the calcined product, all raw materials are analyzed as they arrive at the plant and the calcined coke is sampled constantly and analyzed each day so as to maintain a strict uniformity of quality.

The company also has available the raw or uncalcined petroleum coke for those consumers who prefer to do the calcining themselves at the point of consumption. Constant and rigid inspection at every step in handling of this material from the time it leaves the refinery stills until it is loaded for shipment guards the coke against any chance of contamination.

Chemical Engineer's BOOKSHELF

Battling the Dust Menace

INDUSTRIAL DUST. By *Philip Drinker* and *Theodore Hatch*. Published by the McGraw-Hill Book Co., New York City. 316 pages. Price, $4.

Reviewed by *Charles W. Cuno*

THE SUBJECT of industrial dusts, fumes, mists and gases, has received considerable attention lately, chiefly because of the number of compensation cases before the courts. This book presents a critical discussion of the various phases of the problem of dust control, its relation to the health of workmen, methods of measurement and practical control.

The authors quite definitely consider silicosis as an industrial disease which usually manifests itself in three stages. They state that in the first stage the disease does no measurable harm and produces no disability. Labored breathing is the symptom of the second stage. If allowed to reach the third stage, the victim may contract pulmonary tuberculosis, generally with fatal results. It is inferred that one of the required duties of company physicians in all quartz industries should be to conduct periodic examinations of employees in order that any case of silicosis may be detected in its first stage.

A comparison of various industries on the basis of potential hazard from dust inhalation is presented. Placing the quartz industry at a figure of 100, the other mineral industries such as cement, coal, iron, etc., are all considered to fall between 5 and 10. No rating is made for asbestos. Figures are given which define "permissible dustiness" in the case of silica, coal dust, cement, lead and zinc oxide, manganese, and acetylene and electric welding. It is stated that from an engineering standpoint the safe limits can be easily maintained.

Other subjects covered in the book include asbestosis, allergic reactions to dust, toxic dusts, zinc oxide and metal-fume fever, coal dust, cement, lead, quartz, manganese, suggestions for making a dust survey, and certain measures for the control of dusty conditions.

Because of its scope and fairness, the prominence of its authors, and the institution with which they are connected, this book bids fair to become an authority on the subject of dust control and one to which attorneys on both sides in compensation litigation will undoubtedly refer.

OFFICIAL AND TENTATIVE METHODS OF ANALYSIS OF THE A.O.A.C., Fourth Edition. Published by the Association of Official Agricultural Chemists, Washington, D. C. 710 pages. Price: domestic, $5; foreign, $5.50.

RECOGNIZED as the standard authority and guide in methods of chemical analysis for agricultural and allied products, the A.O.A.C. again brings up to date its compilation of the best of the tested information in that broad-field. Most of the new and revised material appears in the sections on soils, fertilizers, plants, alcoholic beverages, sugars and sugar products, and nuts and nut products. Two former chapters on fibers and paper materials have been omitted because these divisions are being satisfactorily covered elsewhere.

How Big Is "Big Business"?

BIG BUSINESS: ITS GROWTH AND ITS PLACE. By *Alfred L. Bernheim*, editor. Published by Twentieth Century Fund, New York City. 102 pages. Price, $1.35.

Reviewed by *S. D. Kirkpatrick*

FIRST of three volumes to reveal the results of a three-year study of big corporations and their place in American life, this little book is a purely factual and statistical report of research. It draws no conclusions nor points no morals. But it does show some facts and figures that may prove surprising to those who casually think of chemical industry as being largely controlled by the so-called "Big Three." In a compilation of 84 manufacturing industries ranked according to concentration of wage earners, chemical industry is in the 53d place. About 45 per cent of the total number of wage earners are found in the six largest concerns and 33 per cent in the three largest. This compares with 99 and 91 per cent, respectively, in the case of the cigarette industry, 92 and 88 per cent for copper smelting and refining 85 and 78 for rayon, etc. The lowest extreme is the women's clothing industry, in which less than 4 per cent of the workers are employees of the six largest firms and only 2 per cent are of the four largest. For all industries studied, the 512 largest concerns, representing 1.6 per cent of the total number, employed 37 per cent of all wage earners —and owned about 50 per cent of the total corporate assets in 1933. The 69 most prosperous corporations had net incomes of $5,000,000 and over and accounted for about 30 per cent of the total net income of all profitable companies.

When this fact-picture is supplemented by the two succeeding volumes on profits and salaries, a special committee, headed by Ralph E. Flanders, will formulate a program to meet whatever problems, if any, the research reveals.

Theory of Metals

THE THEORY OF THE PROPERTIES OF METALS AND ALLOYS. By *N. F. Mott* and *H. Jones*. Published by the Oxford-Clarendon Press, London. 320 pages. Price $8.

Reviewed by *W. L. Abramowitz*

THOSE METALLURGISTS who take their science seriously and without dilution will appreciate this new monograph from the International Series on Physics. Since the introduction of quantum and wave mechanics the theory of the structures and properties of metals has developed rapidly. Attempts, attended by a remarkable degree of success, have been made to explain the differences between individual metals and alloys in terms of the properties of their constituent atoms, and to correlate the phenomena of cohesion, crystal structure, magnetic susceptibility and the like, with thermal, electrical, and optical data. However, one would still hesitate in adopting Sommerfeld-Slater electron models as guides in the preparation of commercial alloys. In spite of the necessarily highly theoretical treatment, the subject matter is summarized at frequent intervals rather lucidly (for the non-mathematician) and the general worker should find it of value.

Tungsten Treatise

TUNGSTEN, ITS METALLURGY, PROPERTIES AND APPLICATIONS, Second Edition. By *Colin J. Smithells*. Published by D. Van Nostrand Co., Inc., New York City. 272 pages. Price, $8.

Reviewed by *Colin G. Fink*

THIS SECOND revised edition has about 100 pages more than the first edition which appeared ten years ago. The book is devoted primarily to the studies and results obtained in the re-

search laboratories of the British and American General Electric Companies. The subject matter is divided into the following chapters: preparation of tungstic oxide, purification of tungstic oxide, reduction of tungstic oxide, manufacture of ductile tungsten, metallography of tungsten, effect of cold work and annealing on physical properties, properties of tungsten as a function of temperature, thermionic properties of tungsten, tungsten-iron alloys and tungsten steels, non-ferrous alloys and industrial applications of tungsten, hard alloys of tungsten carbide, determination of impurities. The new chapters are those devoted to the ferrous and non-ferrous alloys of tungsten and the cemented tungsten carbides.

SYMPOSIUM ON HIGH-STRENGTH CONSTRUCTIONAL METALS. Published by the American Society for Testing Materials, Philadelphia, Pa. 126 pages. Price: cloth bound, $1.50; paper bound, $1.25.

FIVE TECHNICAL PAPERS dealing respectively with alloys of aluminum and magnesium, alloys of copper, alloys of nickel, carbon and low-alloy steels, and corrosion-resisting steels, along with pertinent discussion, comprise this published report of the A.S.T.M. symposium held at Pittsburgh in March, 1936.

The Legal Side of Business

TRADE AGREEMENTS AND ANTI-TRUST LAWS. By *Harry Aubrey Toulmin, Jr.* Published by the W. H. Anderson Co., Cincinnati, Ohio. 560 pages. Price, $7.50.

AS A LAWYER who makes his daily living as counsel for corporations, ranging all the way from some of the largest in the country to some of the smallest, Dr. Toulmin has reason to know that the questions most often asked by the business man are: "Is my plan legal, yes or no?" If the answer is "no," then follows: "What plan closest to mine is legal?" So he has written this book to aid these executives and their lawyers in answering just these questions—in adjusting their practical business policies to the practical workings of the law.

Because trade agreements underlie or are involved in the Robinson-Patman Act, as well as in the more than twenty State fair-trade and anti-price discrimination laws, this whole subject now assumes new and timely importance. A revival of N.R.A. is being discussed in Washington and already the Walsh-Healey Act has given us an inkling of the type of collateral statutes that are certain to add further complications to manufacturing and industry. Whether we like it or not, the business man and lawyer are going to have to work closer and closer together. And both can profit by what this book can teach about the other's powers and limitations in their cooperative partnership.

Properties of Iron and Steel

DAS TECHNISCHE EISEN, Third Edition. By *Paul Oberhoffer, W. Eilender* and *H. Esser.* Published by Julius Springer, Berlin, Germany. 642 pages, 762 figures. Price, RM 57.

Reviewed by *John Johnston*

IN THE preface of this edition it is stated that the great progress in knowledge of the constitution and properties of steels since 1925, when the second edition of this well-known work was published, has necessitated many alterations and much rewriting. It is also stated that the literature up to the middle of 1935 has been taken into account, yet the thorough author index includes references to less than 30 papers published in English since 1927 and to only four published since 1932. The authors neglect entirely a number of papers, published in English in recent years, which we would regard as of primary importance. The book is thus characteristically German, but good of its kind; its presentation of matters still uncertain is, on the whole, very fair.

It deals with the properties of ordinary commercial carbon steels and, to a lesser extent, of commercial irons, but not at all with manufacturing methods; its includes diagrams of state for the combination of components to be found in ordinary steels, and discusses the influence of rate of cooling upon the attainment of the equilibrium state, as illustrated by the transformation process, the occurrence of aging, the formation of flakes, and generally the effects of non-metallic elements upon the useful properties of steel.

Industrial Chemistry

COURS DE CHIMIE INDUSTRIELLE. By *G. DuPont.* Published by Gauthier-Villars, Paris. Vol. I, 184 pages, 35 fr. Vol. II, 337 pages, 55 fr. Vol. III, 339 pages, 65 fr.

Reviewed by *A. P. Hartlapp*

THIS COURSE in industrial and applied chemistry comprises five volumes, the first three of which are reviewed here. The work preserves a nice balance between theory and practice, and should be of value not only as a textbook for students, but also as a reference book for the professional chemical engineer familiar with French.

The first volume presents a thorough treatment of the numerous methods of practical industrial chemistry concerned with combustibles and their utilization, especially the distillation and cracking of oils and coals.

An up-to-the-minute handling of hydrogenation, ammonia synthesis, and sulphur, halogen, and fertilizer industries, comprises Vol. II. The processes described are supported by calculations of heat balances, critical pressures, recent flow sheets and drawings of equipment.

Ferrous and non-ferrous metallurgy is taken up in the third volume. The author presents many interesting details of ore reduction and the refining of metals. The chapter covering the preparation of alloys is up to date. Of particular interest is the section describing developments in the mechanical and thermic processes for rendering commercial metals.

For Rubber Compounders

COMPOUNDING INGREDIENTS FOR RUBBER. Compiled by the editors of *India Rubber World.* Published by Bill Bros. Publishing Co., New York City. 225 pages. Price, $2.50.

A BRIEF, encyclopedic presentation of the salient facts regarding each of the many compounding materials on the market today, is the content of this little book. It is divided into two parts. The first deals with the ingredients for dry rubber compounding, while the second covers those for the rapidly growing practice of latex compounding. For each material is given the available data on composition, source and physical form, nature of applications, brief chemical and physical properties, specific functions in compounding, methods of use, and where it can be purchased. The book should be useful as a reference to persons engaged in the rubber business or to anyone interested in rubber compounds.

WATER POLLUTION RESEARCH, Vol. X, No. 1, January, 1937. Published by His Majesty's Stationery Office, London. 36 pages. Price, 2s.

SUMMARY of current literature on water pollution research, including water supplies, analysis and examination of water, sewage, trade waste waters, and pollution of natural waters.

German Exposition

ACHEMA VIII. Published by Dechema, 103a Potsdamer Strasse, Berlin W 35. Illustrated, 16 pages.

ANNOUNCEMENT and description of the eighth Achema, German exposition of chemical engineering equipment, to be held July 2 to 11 at Frankfort-on-Main. The exposition has attained international recognition in past years as

one of the most important showings of chemical processing equipment. Exhibits will be housed in four large halls which will be devoted respectively to scientific apparatus and control instruments, equipment made from nonmetallic materials, special processing equipment and complete assemblies of large-scale process equipment.

From Foreign Fields

LES CARBURANTS. By *E. Audibert*. Published by Gauthier-Villars, Paris, France. 178 pages. Price, 45 fr.

THIS MONOGRAPH, the first of three on automotive fuels to be presented by the French National Research Society, provides a comprehensive study of the practices and problems involved in the manufacture of gasoline. The subject matter is well systematized and includes the physical and chemical characteristics of gasoline components (Chap. 1), raw materials—petroleum and natural gas (Chap. 2), and industrial processing (Chap. 3). Of particular interest are the sections on antiknock developments, gum inhibitors, oil fractionation, cracking and refining.

ABFALLSTOFFE DER ANORGANISCH-CHEMISCHEN INDUSTRIE UND IHRE VERWERTUNG. By *Emil Fischer*. Published by Theodor Steinkopff, Dresden & Leipzig, 1936. 156 pages. Price, paper bound, RM 9.

Reviewed by *V. J. Peissachowitz*

IN this monograph (Vol. 36 of a series of reports on progress in chemical technology) the author presents a synopsis of the industrial utilization of waste products in the inorganic chemical industry. Although it does not go into detail, the review handles ably the most important branches of the inorganic chemical industry. It contains also a survey of the literature, German only, and an almost complete list of patents issued on this subject during the last ten years.

BRITISH CHEMICALS AND THEIR MANUFACTURERS, 1937. Published by the Association of British Chemical Manufacturers, 166 Piccadilly, London, W.1. 465 pages. Free to users of chemicals upon request to the Association.

LISTS and classifies British-made chemicals according to scientific name, trade name and manufacturer's trade mark. All information is repeated in six languages: English, French, Spanish, Italian, Portuguese and German, within the one volume. Also gives name, address, telegraphic address, telegraphic code, and telephone number for each of the 125 member companies of the Association of British Chemical Manufacturers.

GOVERNMENT PUBLICATIONS

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Government Reorganization. Report of the President's Committee on Administrative Management in the Government of the United States; 15 cents.

Skin Hazards in American Industry, Part II, by Louis Schwartz. Public Health Service Bulletin 229; 15 cents.

The Selenium Problem in Relation to Public Health, by Maurice I. Smith and others. Public Health Service Reprint No. 1780; 5 cents. A preliminary survey to determine the possibility of selenium intoxication in the rural population living on seleniferous soil.

Acute Response of Guinea Pigs to Vapors of Some New Commercial Organic Compounds—XII. Normal Butyl Acetate, by R. R. Sayers and others. Public Health Service Reprint No. 1769; 5 cents.

Summary of State Reports of Occupational Diseases With a Survey of Preventive Legislation 1932 to 1934, by Margaret T. Mettert. Department of Labor, Bulletin of the Women's Bureau No. 147; 10 cents.

Annual Report of the Commissioner of Internal Revenue, Fiscal Year Ended June 30, 1936; 20 cents. Includes data on alcohol and other commodities bearing special internal revenue taxes.

Statistics on Alcohol, Fiscal Year Ended June 30, 1936. Bureau of Internal Revenue; mimeographed.

Industrial Mobilization Plan. Issued jointly by the War and Navy Departments; 15 cents. Revision of the plan submitted by the War Department in 1931 to the War Policies Commission.

Census of Business. Merchandising practice is summarized for two groups of activities having importance for engineers and executives of process industry. One group relates to the merchandising and the products of those industries, for which there have already appeared, among others, reports on rubber products; perfumes, cosmetics and toilet preparations; pottery and porcelain ware; tobacco products; cleaning and polishing preparations; alcoholic beverages. The second group relates to the methods or channels of merchandising mineral raw materials and ores used by process industry, including bauxite, fluorspar, iron ore.

A Manual for the Safe Handling of Inflammable and Combustible Liquids. Bureau of Marine Inspection and Navigation. A supplement to the general rules and regulations for tank vessels.

Testing of Electrical Instruments, Meters, and Instrument Transformers. Bureau of Standards Letter Circular 475; mimeographed.

Optical Instruments, Refractometry, and Optical Glass Publications (including those in nongovernmental periodicals) by members of the Bureau Staff. Bureau of Standards Letter Circular 485; mimeographed.

Classification of Acoustic Materials. Bureau of Standards Letter Circular 483; mimeographed.

Color Charts. Bureau of Standards Letter Circular 481; mimeographed.

The Machinery-Piping System of Flour Mill Fumigation, by Geo. B. Wagner and others. Bureau of Entomology and Plant Quarantine E-396; mimeographed.

Equipment for Applying Dust Fungicides to Seed Grain, by W. M. Hurst and others. Department of Agriculture Circular 415; 5 cents.

The Effect of Thallium on Plant Growth, by E. E. Horn and others. Department of Agriculture Circular 409; 5 cents.

Selenium Occurrence in Certain Soils in the United States, With a Discussion of Related Topics, Second Report, by Horace G. Byers. Department of Agriculture Technical Bulletin 530; 10 cents.

Foreign Trade of the United States, Calendar Year 1935, by Grace A. Witherow. Bureau of Foreign and Domestic Commerce Trade Promotion Series 166; 20 cents.

Foreign Commerce and Navigation of the United States, 1935. Bureau of Foreign and Domestic Commerce; $2.25 (buckram). Contains quantity and value of imports and exports by commodities.

Survey of Current Business, 1936 Supplement. Bureau of Foreign and Domestic Commerce, unnumbered document; 35 cents. Summarizes business statistics for 1932 through 1935, by months.

Photographic Film for Miniature Copies of Records. Bureau of Standards Simplified Practice Recommendation R165-36; 5 cents.

Abrasive Grain Sizes. Simplified Practice Recommendation R118-36; 5 cents.

The Taxing Power of the Federal and State Governments. Report to the Joint Committee on Internal Revenue Taxation.

Handbook of American Trade-Unions, 1936 Edition, by Estelle M. Stewart. Bureau of Labor Statistics Bulletin 618; 30 cents.

Handbook of Labor Statistics, 1936 Edition. Bureau of Labor Statistics Bulletin 616; $1.25, 1151 pages.

A Selected List of the Publications of the Bureau of Labor Statistics, 1936 Edition, by Elizabeth A. Johnson. Bureau of Labor Statistics Bulletin 624; 10 cents.

Regulations Prescribed by the Secretary of Labor Under Public Act No. 846, 74th Congress. Department of Labor No. 504; 5 cents.

Canadian-American Trade, Analysis of the First Half Year Under the Reciprocal Agreement. Department of State, Commercial Policy Series No. 32; 5 cents.

Changes in Import Duties Since the Passage of the Tariff Act of 1930. Tariff Commission, Miscellaneous Series, Third Edition, January 21, 1937; 10 cents.

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A Microcolorimetric Method for the Determination of Toluene, by W. P. Yant and others. Bureau of Mines Report of Investigation 3323; mimeographed.

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Cooperative Fuel Research Motor-Gasoline Survey, Summer, 1936, by E. C. Lane. Bureau of Mines Report of Investigations 3335; mimeographed.

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Your Plant NOTEBOOK

ALIGNMENT CHART FOR INTERPRETING ORSAT ANALYSES OF FLUE GAS

By W. K. Woods
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Massachusetts Institute of Technology
Cambridge, Mass.

RAPID INTERPRETATION of Orsat analyses of flue gas is facilitated by the accompanying alignment chart. Only one setting of a straight-edge is necessary, and by fixing any three of the five variables (per cent CO_2, per cent CO, per cent O_2, net hydrogen: carbon atomic ratio, and per cent excess air) the other two may be read off directly. The chart is applicable to all combustion processes where (1) the fuel contains negligible amounts of material other than hydrogen, carbon, moisture, and non-volatile ash, and (2) unburnt combustible is either negligible in amount or has a ratio of net hydrogen to carbon negligibly different from that of the burnt combustible. The Orsat analyses are expressed as percentages by volume on a dry basis.

Example 1—A flue gas shows the following Orsat analysis: 12 per cent CO_2, 2 per cent CO, and 4 per cent oxygen. What is the ratio of net hydrogen to carbon in the fuel and what is the percentage excess air? Place a straight-edge so that it intersects the left-hand vertical scale (CO_2) at 12 per cent and the right-hand vertical scale (O_2) at 4 per cent. Reading off the 2 per cent CO lines, the net hydrogen: carbon ratio is read as 1.4 and the excess air is 16 per cent (down from intersection with 2 per cent CO line).

Example 2—A coke-fired furnace has a flue gas Orsat analysis of 14 per cent CO_2 and 6.4 per cent O_2. What is the carbon monoxide content of the flue gas? What is the percentage excess air? Pass a straight-edge through the 14 per cent mark on the left-hand vertical CO_2 scale and 6.4 per cent on the O_2 scale. The straight-edge intersects the vertical line of net hydrogen: carbon = 0 at 1 per cent CO. The straight-edge also intersects the right-hand 1 per cent CO line (interpolated) at 40 per cent excess air.

Example 3—A shell still is fired with a gas substantially ethane (net hydrogen : carbon ratio = 3.0). A CO_2 recorder indicates 8 per cent CO_2 (dry basis) in the flue gas. Assuming negligible carbon monoxide in the flue gas, what is the oxygen analysis of the flue gas and the percentage excess air? What answers are obtained by assuming 1 per cent CO?

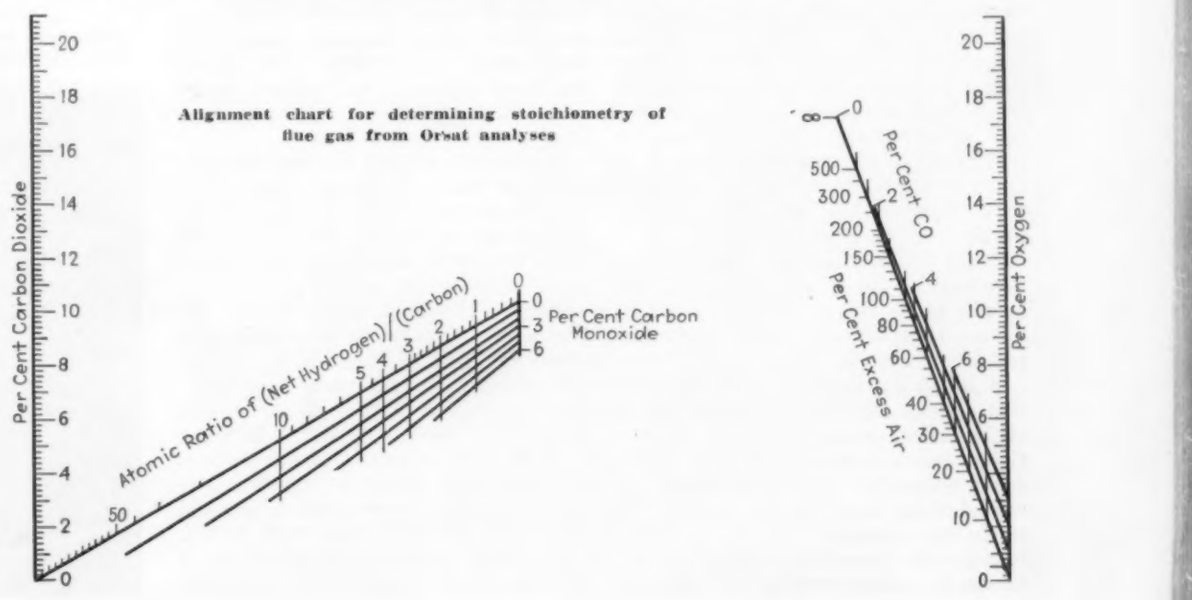
Pass a straight-edge through 8 per cent on the CO_2 scale and through the 0 per cent CO line at net hydrogen : carbon = 3. The straight-edge intersects the O_2 scale at 8.3 per cent and crosses the other 0 per cent CO scale at 60 per cent excess air. When the 1 per cent CO lines are used the corresponding values are 7.1 per cent O_2 and 42 per cent excess air.

ANHYDROUS AMMONIA USEFUL IN TESTING TIGHTNESS OF EQUIPMENT

By L. H. Brandt
National Ammonia Division
E. I. du Pont de Nemours & Co., Inc.
Philadelphia, Pa.

IN AN INCREASING number of process industries it is essential that valves, gages, pipe connections, rivets and welds be absolutely tight to prevent the leakage of poisonous or explosive fluids and gases or the infiltration of air into easily oxidized materials.

The use of compressed air with immersion under water is not a satisfactory method for determining extremely small leaks. Frequently, also, the unit to be tested is too large for submersion and in such cases the painting of joints with soap suds, or similar materials, does not



Alignment chart for determining stoichiometry of flue gas from Orsat analyses

give satisfactory results. This is especially true in testing joints which are relatively inaccessible.

In many cases the use of anhydrous ammonia gas has been found eminently satisfactory. Ammonia has a low molecular weight and therefore gives excellent penetration through small openings. As liquid anhydrous ammonia has a high vapor pressure, a cylinder of this liquid will exert sufficient pressure for most testing. Minute traces of escaping ammonia can readily be detected by exposing them to acid fumes, such as sulphur dioxide produced by a burning sulphur taper, thus forming a dense white cloud.

One of the earliest applications of ammonia in this way was for the testing of special gages and valves. These were simply connected to an ammonia cylinder. At 70 deg. F. the vapor pressure of anhydrous ammonia amounts to 114 lb. ga., which was usually sufficient for the purpose. The presence of any leaks could be found by passing a burning sulphur taper over all parts suspected of leakage. This test, of course, is best adapted to steel parts, although by excluding any moisture and completely removing ammonia after the test, it could be applied to copper-bearing alloys. Strictly dry ammonia is not corrosive to copper.

In the manufacture of welded coils, a submersion or soap-and-water test may not be satisfactory because many parts of the coil are not readily accessible for inspection. When using anhydrous ammonia a burning sulphur taper can easily be passed around all joints and any small leaks detected. Several purchasers of high pressure coils specify that they be tested with anhydrous ammonia prior to leaving the fabricator's shop. A specification of this kind is especially desirable for coils to be used in unit type household or semi-commercial refrigerators which must operate for a number of years with the original charge of refrigerant. Any small leak would be disastrous on account of excessive service costs. In equipment for the handling of metallic sodium it is essential that certain coils be absolutely tight to prevent the infiltration of water or air.

Small high-temperature or high-pressure heat exchange units frequently are bought under ammonia tested specifications. These units are particularly susceptible to leakage in inaccessible spots.

A recent development in the construction of tank cars for the transportation of hazardous chemicals is to test the tightness of anchor rivets with anhydrous ammonia. The rivet heads are welded along the edges and on the inside of the car a hemispherical cap is welded to cover the inner head. Anhydrous ammonia introduced within this cap will show any leakage either around the rivet or in the cap itself. After testing, the cap is sealed and provides an additional safeguard against leakage in the event mechanical strain loosens the rivet.

A variation of the same method is employed in the testing of mechanical unit refrigerators charged with sulphur dioxide. These small units are intended to operate over an extended number of years on their original, extremely small, sulphur dioxide charge. To insure complete tightness of the entire unit they are charged and put in operation in a hood containing ammonia fumes. Any sulphur dioxide leak will be shown at once by the presence of heavy white fumes within the hood issuing from the leak.

As stated before, tests of this kind are particularly useful for iron parts. Under such testing conditions ammonia has practically no effect on iron either in the presence or absence of moisture. Moist ammonia does corrode copper and most of its alloys. When it is necessary to test such materials with ammonia special care should be taken to exclude moisture and to remove completely ammonia following the test. To effect removal it is simply necessary to blow air through the part which has been tested. The complete removal of ammonia can readily be determined either by the absence of ammonia odor or by holding a burning sulphur taper in the effluent stream of air.

The commonest and handiest way to obtain acid gas is to burn a sulphur taper and produce sulphur dioxide. Tapers may be obtained through any ammonia manufacturer. Tapers can easily be made by impregnating a cotton wick with molten sulphur. They can be made up individually, or in bulk by passing a length of wick through a bath of molten sulphur. In some cases a bottle of fuming hydrochloric acid can be used to replace the sulphur taper. A disadvantage of hydrochloric acid is the danger of spilling it and causing severe corrosion to metal. It cannot be used in out-of-the-way locations.

It should be pointed out that although ammonia cannot be ignited under ordinary conditions, it may, especially when compressed or heated, ignite with air when present in concentrations between about 15 per cent and 28 per cent by volume. Normally, when testing, the percentage of ammonia is considerably above the limits of flammability. When testing large systems under high pressure, especially where there is any danger of a spark, care should be taken to keep away from the limits of flammability. In a number of industries air-ammonia mixtures are handled daily and experience indicates little real hazard.

A pound of anhydrous ammonia at 70 deg. F. and expanded to room temperature occupies a volume of about 22.5 cu.ft. At the same temperature anhydrous ammonia gas at its vapor pressure of 114 lb. ga. occupies a volume of 2.3 cu.ft. The amount of ammonia required for testing moderate sized equipment is quite small. For testing very large equipment a mixture of ammonia and air can be used, taking care to avoid the limits of flammability. It would be preferable to employ ammonia plus nitrogen. Carbon dioxide is not suitable for building up high pressures because ammonia and carbon dioxide readily react to give ammonium carbonates. Obviously, cylinder oxygen should never be used to give additional pressure.

Portable Trap Hastens Tank Car Heating

A NOVEL and useful device discussed in a recent issue of *The Armstrong Trap Magazine* is a portable steam trap for heating tank cars. The idea was conceived by M. S. Rexford, chief engineer of the Gustafson Oil Co., Chicago. In order to obviate the inherent inefficiency of hand operated valves on a tank car heating system, Mr. Rexford provided an Armstrong bucket trap with a tripod and a length of rubber steam hose. This is connected to the drip connection of the car coil and the steam turned on. Heating time, according to Mr. Rexford, has been decreased from 5½ to 3½ hours, a tidy saving of 36 per cent. The trap needs no attention, whereas several adjustments of the cracked valve were required when manual control was used. Furthermore, boiler pressure now holds constant and substantial savings in fuel are being effected.

Steam trap equipped with tripod and hose connection for tank car heating

News of EQUIPMENT

Gyratory Pulverizer

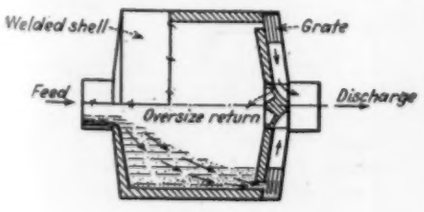
"Centriflex" is the name of a new gyratory pulverizer which utilizes a floating centrifugal eccentric and is manufactured by the McNally-Pittsburg Mfg. Corp., Pittsburg, Kansas. The pulverizer consists of a cone-shaped mantle inclosing a cone-shaped muller, in the center of which is a rotating crank. The muller does not revolve with the crank, but swings freely, pulverizing material against the mantle. Instead of a positive connection between crank and muller, as in other gyratory pulverizers, there is a yielding link which is described as a floating centrifugal eccentric. As the crankshaft revolves, the resistance of the material, the action of the bumper on the crank and the centrifugal force of the eccentric combine to oscillate the eccentric on the crank. This greatly multiplies the number of blows struck by the muller against the mantle, reducing the material to fine sizes with a minimum consumption of power. The pulverizer is said to require only a third, occasionally only a sixth of the power consumed by other pulverizers of equal capacity.

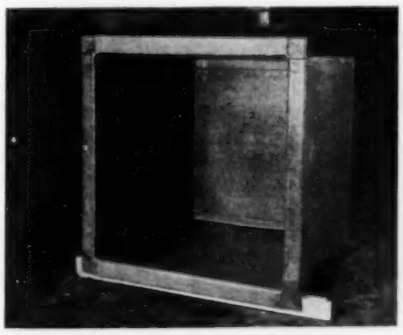
Grated Discharge Mill

Combining the controlled discharge characteristics of a diaphragm or grated-type ball mill, with the high circulating load capacity of an overflow-type mill, the new Abco positive grated discharge mill has been announced by the American Ball Mill Co., Patterson Building, Denver, Colo. As indicated by the illustration, all product acceptable to the grate is immediately trapped at the periphery and ejected by gravity through the trunnion. According to the manufacturer, there is no chance for slippage and material moves through the mill so rapidly that over-grinding cannot take place. At the same time, the construction is said to eliminate any possibility of choking or blinding of the grates. A low pulp line can be maintained and a lighter ball load is practical and desirable. Grates are protected from contact with the balls. A circulating load as high as 1,800 per cent can be maintained if desired.

Other features include boltless liners, a one-piece electric welded shell, and the use of self-aligning anti-friction bearings as standard equipment.

Cross section of positive grated discharge mill

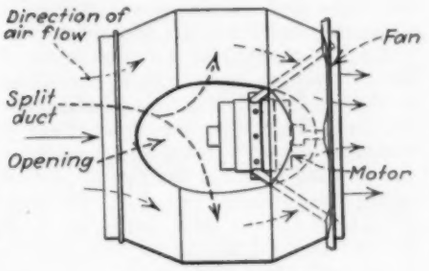




Welded steel tank with Koroseal lining

Koroseal Tank Linings

One of the newest applications for Koroseal, the synthetic rubber-like material developed by the B. F. Goodrich Co., Akron, Ohio, is its use in tank linings for handling severely corrosive materials, particularly oxidizing acids. Methods have been developed for attaching the Koroseal to steel, wood and cement, giving good adhesion to the base material. Linings cannot be applied to riveted tanks, but welded constructions are satisfactory. Typical installations include steel tanks for handling 67 per cent nitric acid at 130 deg. F., and wood tanks for stainless steel pickling with a mixture of nitric and hydrofluoric acids. The material is subject to physical damage which, however, can be readily repaired. However, this may be averted by means of a protective lining of acidproof brick or other material. Since Koroseal is thermoplastic, it should not be used at temperatures over 150 deg. F. without such a protective sheathing to serve as insulation.



New duct-mounted fan

Duct Fan

"Bifurcator" is the name of a new type of straight-line fan for mounting in ducts without changing the duct direction, that has been put on the market by the De Bothezat Division of American Machine & Metals, Inc., 100 Sixth Ave., New York City. Essentially, this is a direct-motor-connected pressure disk fan, mounted in a split section of duct, the two halves of which pass either side of the motor. The new fan is compact, light in weight and requires no supporting platform. It may be installed in any ventilating duct, and since it removes the motor from the gas stream, does not require a motor with special protection, although a fully inclosed motor can be used if desired for other reasons. The device can be supplied in special metals of any sort needed to meet unusual conditions of corrosion or abrasion.

Equipment Briefs

Sarco Co., Inc., 183 Madison Ave., New York, N. Y., announces completion of a new line of electric temperature controls for heating, air conditioning, refrigeration and industrial processes. These are based on patents and designs acquired from the Wilbin Instrument Corp., which concern has been liquidated. In principle they are similar to the instruments described on page 279 of our May, 1935, issue. The thermostats range from simple room types to multiple contact-point indicating types for industrial use. Motor valves are of both open-and-shut and throttling types, held in the desired position by hydraulic pressure generated by a small motor-driven vane pump.

A new line of non-lubricated compressors for use in special process work where the presence of lubricating oil is detrimental has been announced by

the Sullivan Machinery Co., Woodland Ave., Michigan City, Ind. The piston is provided with special self-lubricating rings while the cylinder liner is of especially accurate bore, honed to satin smoothness. This construction is available in single-stage compressors for both belt and steam drive.

Combination of two power transmission developments of the past few years has resulted in a combination of the advantages each offers, according to the Rockwood Mfg. Co., Indianapolis, Ind. This company now offers a complete line of V belts, and these belts can be used with the Rockwood pivoted motor base which was formerly supplied only for use with flat belts. It is claimed that the use of the pivoted base is advantageous with V belts, in that this type of transmission medium also is inclined to stretch over a period of time. The pivoted base takes up this stretch, but at the same time relieves the tension and permits the belt to "rest" during periods of inactivity.

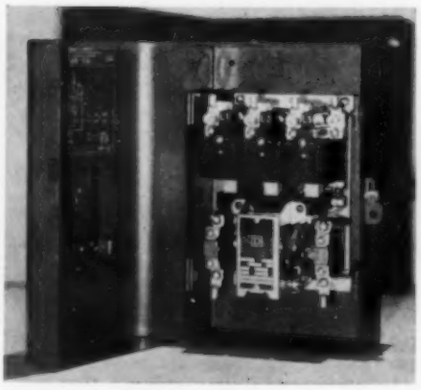
For use on recording meters, the charts of which are of daily value only and are discarded after the day's run, the Permochart Corp., 295 Madison Ave., New York City, has developed a smooth, hard-surfaced recording chart which can be cleaned repeatedly by the use of a water-dampened cloth and used hundreds of times without chart replacement. Charts in daily use are stated to have lasted over three years under normal operating conditions. In applications where they can be used, the new charts are said to have given average savings in excess of 85 per cent per year.

Automatic Motor Starter

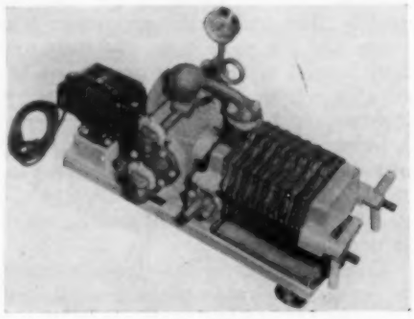
Accessability, ready replacement of parts, vertical closing action and compactness are major features of a new a.-c. automatic starter for electric motors recently announced by the Square D Co., 710 South 3d St., Milwaukee, Wis. The new starter, which is known as Type T, Class 8636, is a line-voltage type and can be used to start polyphase, squirrel-cage motors directly across the line, at full voltage where the application permits. Sizes at present include units for polyphase motors from 7½ to 25 hp. and single-phase motors from 3 to 7½ hp.

Portable Filter Press

For use in laboratories, pilot plant work and small industrial applications, T. Shriver & Co., Harrison, N. J., has announced a small portable filtration unit consisting of a plate and frame filter press and an electric-motor operated diaphragm pump, with starting switch, cord and plug. The unit is



New motor starter with case opened



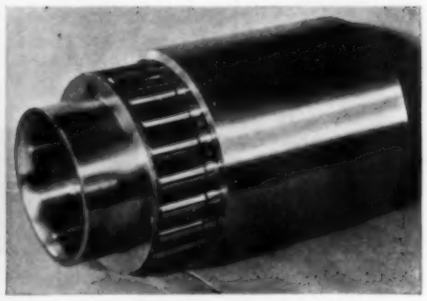
Small portable filter press unit

mounted on a portable stand equipped with roller-bearing casters. Overall, it measures 35 x 16 in. In the press illustrated, which has eight chambers, the filtering capacity ranges upward to 90 g.p.h. Any desired material of construction can be supplied. If necessary, recessed plates, rather than plates and frames, can be provided.

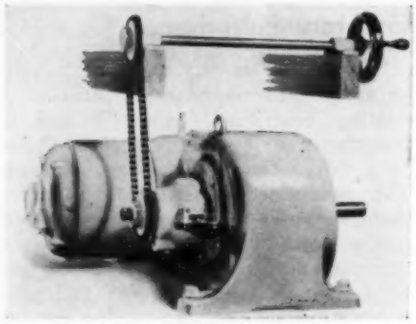
Heavy Duty Bearings

For use in heavy machinery as in paper mills, rubber and oil field equipment, and the like, where especially severe service requirements must be met, the Fafnir Bearing Co., New Britain, Conn., has developed a complete series of heavy-duty industrial roller bearings, made in an extended range of almost 100 sizes with rated capacities ranging from 10,000 to 500,000 lb. A choice of 18 different bores is offered in bearings of this type. These bearings feature a large number of solid rolls which are incorporated in the cage assembly, making for increased load capacity. All parts of these bearings are ground to extremely close tolerances.

Another new development of this company is a heavy-duty pillow block for roller bearings involving end thrust in addition to radial load. A separate, heavy-duty ball bearing to take the thrust loads is included as an integral part of the assembly. Thus,



Industrial roller bearing



Remote control applied to Varidrive motor

Boom type box car loader

all of the radial load is taken by the roller bearing, while all forces tending to displace the shaft axially are borne by the ball bearing. A spherical housing construction provides self-alignment.

Remote Drive Control

U. S. Electrical Motors, Inc., 200 East Slauson Ave., Los Angeles, Calif., announces the standardization of a line of parts for obtaining remote mechanical control of the variable speed transmissions which it supplies. These parts include bearing supports, shafting, sprockets and chains, with which the speed control element of the U. S. Varidrive motor can be connected to a handwheel at any reasonably remote point.

Box Car Loader

An inexpensive box car loader for the handling of bulk materials with the minimum creation of dust has been developed by the Link-Belt Co., 2045 Hunting Park Ave., Philadelphia, Pa. An anti-friction belt conveyor, which

is the loading element of the machine, is so supported on a horizontal boom that it can either be racked back and forth, or rotated through 360 deg. on its caster mounting. The conveyor driven by an electric motor, is operated at a comparatively slow speed and has a discharge height of 5 ft. It can be moved in and out of cars by three men, and attended in operation by one man.

Improved Respirator

A larger filter area, making for easier breathing; extremely light weight; and greater comfort because of unobstructed vision, are important features of a new Dupor plate respirator, recently announced by H. S. Cover, Station A, South Bend, Ind. The new respirator, which has been approved by the U. S. Bureau of Mines for pneumoconiosis-producing dusts, has a filter area of more than 24 sq.in. Without the filter pads, the respirator weighs but 4 oz.

Furnace Construction

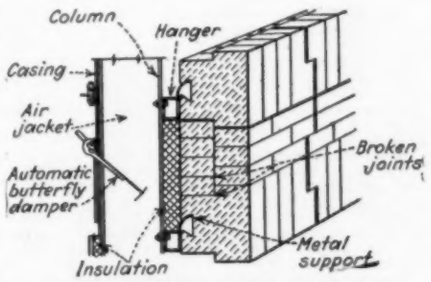
A new design of supported furnace wall has been announced by Geo. P. Reintjes Co., Kansas City, Mo. The wall is sectionalized, each section being built totally independent of any other section. The weight of all refractories is transferred to a supporting steel framework. The wall is designed in such a manner that all supporting metal is entirely in back of the refractory where it can be cooled by circulating air. All joints are broken to prevent air infiltration. The spacing of the refractory belts can be varied simply by increasing or decreasing the number of courses of standard firebrick. These features are indicated in the accompanying sketch which shows the special refractory shapes, the metal supports, the standard shapes and the air jacket, together with a method of applying insulation to refractories and casing if such insulation is desired.

Dry Chemical Feeder

For extreme accuracy in the dosing of water with dry chemicals, the Syntron Co., 400 North Lexington Ave., Pittsburgh, Pa., has developed a new continuous batch-weighing feeder which weighs out the material in small batches, then automatically discharges the batches once, twice, three or four times per minute, as desired. The machine consists of a supply hopper provided with a noiseless electric vibrator to prevent arching. This feeds to a vibratory feeder which in turn discharges into a weigh hopper mounted on an even-balance scale. The scale is equipped with electric contacts which stop the feed conveyor at exactly the correct weight. An electric clock control then dumps the contents of the weigh hopper into the solution pot at whatever interval is selected. The outfit has a capacity range from $\frac{1}{8}$ oz. to 1 lb. per discharge. It is said to maintain an accuracy of plus or minus $\frac{1}{2}$ per cent in the feeding of such materials as activated carbon, lime, soda ash and alum.

Long Mesh Screen

An improvement in the construction of long-mesh woven-wire screens, announced by the Ludlow Saylor Wire Co., St. Louis, Mo., is designed to prevent the stretching and breaking of such screens when they are placed under side tension in vibrating screen equipment. The new Sta-Tru screen avoids this difficulty by the inclusion of uncrimped tensile members which are woven into the screen in combination with two or more crimped spacing wires. The latter maintain the spacing of the longitudinal wires, while the tension members take the tension necessary properly to support the screening surface. Much longer screen life is said to result.



Section of supported furnace wall

Jacketed Mill

A new line of jacketed continuous feed and discharge tube mills, which can be heated or cooled during the grinding operation, has been introduced by the Patterson Foundry & Machine Co., East Liverpool, Ohio. Either steam or hot oil can be used, or if desired, a cooling medium such as cold water or brine can be circulated through the jacket. According to the manufacturers, a number of processes are now being carried out in this machine.

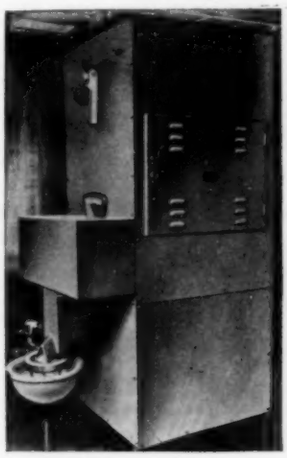
Equipment Briefs

A line of integrated rotary pump units, comprising a rotary pump, speed reducer and motor mounted on a base, has been announced by the Blackmer Pump Co., Grand Rapids, Mich. The new arrangement permits economies in first, installation and operating cost, as well as in maintenance. Single and twin units are available with an overall capacity range from 35 to 1,000 g.p.m.

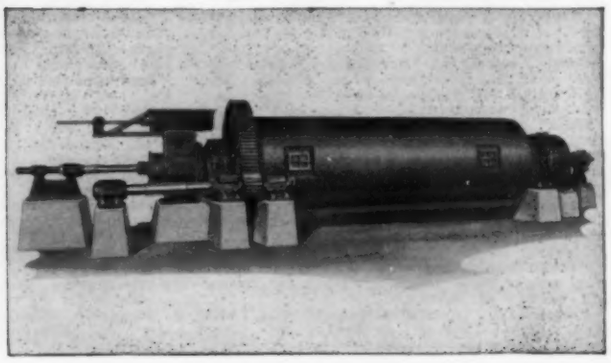
A new two-quart vertical laboratory colloid mill, of unusually low price, has been announced by Eppenbach, Inc., 45-10 Vernon Blvd., Long Island City,

Section of reinforced long-mesh screen designed to prevent stretching

New light-weight respirator


Left: Feeder for chemicals

Jacketed tube mill for continuous feed and discharge



N. Y. The new machine uses a ½-hp. universal motor, weighs 14 lb. and has a bypass arrangement and adjustable rotor gap. Stainless steel is used for the working parts. This mill is known as Vertical No. 1. Vertical No. 2, a mill of 8 qt. capacity, is also available.

Sullivan Machinery Co., Michigan City, Ind., has developed a new steam-driven compressor for steam pressures of 80 to 250 lb. and air pressures up to 150 lb. The machine is of horizontal, single-stage construction and is built in capacities from 279 to 1,987 c.f.m. It is given the designation WA-7. Various controls are available depending on the type of service desired. Antifriction bearings and laminated cushion-back valves are features adding to efficiency.

According to the manufacturer, all of the comfort and safety features of its regular Ful-Vue goggles have been incorporated in the new F-3105 goggle of the American Optical Co., Southbridge, Mass. In addition, the new goggles have wire-mesh side shields to provide extra protection against particles striking from any direction. The metal frame is of corrosion-resisting metal.

Two new Condor compensated belts, known as Styles F and B, have been developed by the Manhattan Rubber Manufacturing Division, Raybestos-Manhattan, Inc., Passaic, N. J. Both types employ the patented principle of equalized ply stresses at the arc of contact, but are designed for unusual conditions where some slip is required. They differ from the standard compensated belts only in the friction characteristics of the pulley-contact surface.

MANUFACTURERS' LATEST PUBLICATIONS

Agitators. New England Tank & Tower Co., Everett, Mass.—Bulletin 370—76 pages covering this company's complete line of agitating equipment, with engineering data section devoted to performance and power requirements of agitators.

Air Conditioning. Carbondale Division, Worthington Pump & Machinery Corp., Harrison, N. J.—Bulletin 1122—8 pages on a new line of unit air conditioners announced by this company.

Alloys. Beryllium Corp. of Pennsylvania, Reading, Pa.—Leaflet describing properties and uses of beryllium-copper alloys.

Alloys. International Nickel Co., 67 Wall St., New York City—Bulletin U-2—11 pages on the use of nickel alloy steels in petroleum production equipment. Also 20-page booklet on the use of Monel metal and nickel in the chemical industries, presenting much information in condensed form, including data on properties and on uses.

Centrifugals. American Tool & Machine Co., Hyde Park, Boston, Mass.—8-page bulletin describing types of centrifugal separation equipment made by this company, also discussing unusual applications.

Chemicals. Paul-Lewis Laboratories, 918 N. 4th St., Milwaukee, Wis.—11-page price list of biological and organic chemicals produced by this company.

Chemicals. Solvay Sales Corp., 40 Rector St., New York City—40-page booklet on history, properties, uses and handling of liquid chlorine.

Consultation. Bull & Roberts, 117 Liberty St., New York City—8-page booklet describing the services of chemistry to the shipping industry, with information on facilities and personnel of this consulting firm.

Diesels. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.—20-page booklet illustrating and briefly describing this company's complete line of diesel engines for stationary and portable service; also Bulletin 3600-A1, 16 pages describing Model 36-A diesel power units for industrial use.

Dust Collection. Dracco Corp., Harvard Ave. and East 116th St., Cleveland, Ohio—Bulletin 250—8-page booklet briefly describing this company's automatic filters for dust and fume recovery.

Dust Collectors. Northern Blower Co., West 65th St., Cleveland, Ohio—Bulletin 163-1—4 pages descriptive of this company's bag-type dust arresters.

Dust Collectors. Parsons Engineering Corp., 6511 Cedar Ave., Cleveland, Ohio—Bulletin DA-6—6-page booklet describing this company's oval bag dust arresters, listing typical users.

Electric Wiring. Anaconda Wire & Cable Co., 25 Broadway, New York City—Industrial wiring survey form, including discussion of procedure in investigating condition of the electrical equipment and wiring in industrial plants, with suitable forms for recording results of survey.

Enameling. Ferro-Enamel Corp., Cleveland, Ohio—75-page dictionary of terms used in the enamel industry.

Equipment. Alberene Stone Corp. of Virginia, 419 Fourth Ave., New York City—4-page leaflet describing typical sinks made of Alberene stone.

Equipment. Louisville Drying Machinery Co., Louisville, Ky.—32-page general catalog concerning this company's line of direct and indirect heated rotary dryers, continuous filters and screen and screw type dewatering equipment.

Equipment. The Steel Improvement & Forge Co., 960 Addison Road, Cleveland, Ohio—20-page book of technical data and general information on drop forged manhole and handhole covers and cover assemblies made by this company.

Feeders. Proportioneers, Inc., 9 Codding St., Providence, R. I.—Bulletin "PER"—8 pages on proportioning equipment for water treatment including hypo-chlorinators, proportional meters for hypo solutions, meters for ferric chloride and for pH control.

Floodlights. Crouse-Hinds Co., Syracuse, N. Y.—Extensive loose-leaf catalog covering numerous types of floodlights for industrial and other purposes.

Gaskets. Goetze Gasket & Packing Co., New Brunswick, N. J.—24-page Golden Anniversary Booklet illustrating this company's facilities for producing a wide variety of gaskets.

Heaters. Harold E. Trent Co., 618 N. 54th St., Philadelphia, Pa.—Leaflet describing electrical space heaters including fan and fanless types.

Hose. U. S. Rubber Products, Inc., 1790 Broadway, New York City—48-page catalog covering a wide variety of rubber hose for industrial use.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 2004—56 pages describing this company's complete line of electric and mechanical flowmeters.

Instruments. Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa.—Bulletin 2094—16 pages illustrating and describing construction of this company's high torque mechanical flowmeter.

Instruments. Coleman Electric Co., 300 Madison St., Maywood, Ill.—Complete discussion of the measurement of pH with the glass electrode; includes bibliography of some 130 references.

Instruments. Julien P. Frietz & Sons, Inc., Baltimore St. & Central Ave., Baltimore, Md.—Bulletin F—4 pages describing this company's pitot tube air meters; also draft gages.

Instruments. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.—Interesting cutout bulletin showing various sections through the latest model of Micromax potentiometer recorder, describing construction and operation.

Lighting. Benjamin Electric Mfg. Co., Des Plaines, Ill.—36-page manual of factory lighting practice, describing practical solutions to 30 common lighting problems.

Magnetic Separation. Stearns Magnetic Mfg. Co., Milwaukee, Wis.—170-page "Magnetic Hand Book," with technical data, illustrations and descriptions covering various phases of magnetic separation and concentration, together with magnetic power transmission equipment.

Materials Handling. Standard Conveyor Co., North St. Paul, Minn.—Folder describing and showing applications of this company's portable elevators for piling and stacking bags, bales, bundles and barrels.

Mixers. Turbo-Mixer Corp., 241 Park Ave., New York City—19-page loose-leaf collection of bulletins covering types of Turbo-mixers and uses in process industries.

Motors. Century Electric Co., 1806 Pine St., St. Louis, Mo.—Bulletin 2-1—8 pages on single-phase, brush-lifting, repulsion-start induction motors in sizes from ⅛ to 40 hp.

Power Transmission. Alexander Bros., Inc., Philadelphia, Pa.—Catalog A-116—32 pages with engineering data, covering power transmission leather products; also leather packings and industrial leathers.

Power Transmission. Sprout, Waldron & Co., Muncy, Pa.—Bulletin H-1—24 pages on cast iron pulleys with engineering data; also steel pulleys, bearings and hangers.

Precipitators. Pangborn Corp., Hagerstown, Md.—Bulletin 904—6 pages describing principles, construction and application of a new electrostatic precipitator developed jointly by this company and Westinghouse Electric & Mfg. Co.

Pumps. Economy Pumping Machinery Co., 3431 W. 48th Place, Chicago, Ill.—235-page Pump Data Handbook describing and giving data on this company's numerous types of pumps; gives much useful information on hydraulics, pump installation and piping.

Pumps. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill.—Bulletin 6160—12 pages on this company's standard and heavy duty duplex power pumps.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Bulletin 208—Describes 21 sizes of this company's close-coupled centrifugal pumps for capacities to 1,600 g.p.m.

Pumps. Ingersoll-Rand Co., 11 Broadway, New York City—Form 2095—Folder describing construction of this company's Cameron Class BJV hot oil pumps for petroleum refineries.

Pumps. Kinney Mfg. Co., 3529 Washington St., Boston, Mass.—Bulletin 14—4 pages describing this company's Type SD rotary pumps.

Refractories. A. P. Green Fire Brick Co., Mexico, Mo.—16-page book completely describing production of this company's Empire firebrick.

Safety Equipment. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh, Pa.—Catalog 5-B—128 pages devoted exclusively to safety equipment for industrial use.

Screening. Robins Conveying Belt Co., 15 Park Row, New York City—Bulletin 98—8 pages on this company's screen cloth for vibrating screens.

Steam Generation. Babcock & Wilcox Co., 85 Liberty St., New York City—Booklet describing this company's direct-firing pulverized coal system for boilers. Also 32-page bulletin listing grindabilities and analyses of many coals mined in the United States, Canada and other countries.

Technical Books. Chemical Publishing Co., 148 Lafayette St., New York City—Catalog 4—133-page catalog of technical books, listing thousands of volumes of American and British publishers.

Tubes. Revere Copper & Brass, Inc., 230 Park Ave., New York City—44-page book describing production and properties of seamless condenser tubes and tube plates.

Valves. Automatic Switch Co., 154 Grand St., New York City—Catalog 20—32 pages describing a wide variety of solenoid-operated valves offered by this company.

Valves. Ross Operating Valve Co., 6488 Epworth Blvd., Detroit, Mich.—Catalog 36—24 pages covering a variety of hand, foot, mechanical and electrically operated control valves for air and hydraulic equipment.

Water Analysis. W. H. & L. D. Betz, 235 W. Wyoming Ave., Philadelphia, Pa.—Third edition of this company's booklet on water analysis, covering in 32 pages this company's water analysis services, and the chemicals and apparatus supplied.

Water Treatment. Cochrane Corp., 17th St. and Allegheny Ave., Philadelphia, Pa.—Bulletin 2540—16 pages illustrating and describing this company's feedwater deaerators.

Welding. Lincoln Electric Co., Cleveland, Ohio—Specification Bulletin 318—4 pages describing 200-amp. engine-driven arc welder.

Welding. Lincoln Electric Co., Cleveland, Ohio—Revised edition of this company's "Lessons in Arc Welding," a brief but comprehensive series of 44 lessons in 130 pages, imparting a practical working knowledge of arc welding. Price, 50 cents.

Chemical Engineering NEWS

German Equipment Makers Perfect Plans for Achema

GERMANY'S exposition of chemical engineering equipment, internationally known as "Achema" will be held for the eighth time this year in Frankfort-on-Main, July 2-11. Judging from its scope and expected attendance, it will surpass all of its predecessors including the 1930 Exposition in Frankfort and the 1934 Exposition in Cologne—the latter of which was attended by 48,600 visitors from 46 countries. To date more than 300 firms have reserved exhibition space, some of which include full-scale process equipment for commercial manufacture of plastics, rayon and similar products. Meeting in conjunction with the Achema VIII, the Association of German Chemists will hold its Fiftieth Anniversary Congress. For the first time a special "Day of German Technic" will be held in connection with the Chemical Exposition to show the progress being made in the current program of chemical development under the national 4-year plan.

In seven halls, ranging from 4,000 to 80,000 sq.ft. each, there will be concentrated the exhibits of scientific apparatus and instruments, control and regulatory apparatus, technical equipment, machinery and accessories for processing non-metallic materials, synthetic products, plastics, artificial silk and related industries, metals, alloys and other materials of construction, packing and packaging machinery and current literature on the development and work of German scientific societies and associations.

A comprehensive "Achema Yearbook 1937" containing information in English on the progress of arrangements for the event and a detailed advance report on "What the Achema VIII Offers," has been issued by the managing organization "Dechema" of 103 Potsdamer Str., Berlin, Germany. This book is available to interested parties who send their request accompanied by three international reply coupons to cover foreign postage.

Plans are under way in the United States for organizing a group of American chemical engineers and executives to make an inspection trip of German chemical industries and research laboratories which would include attendance at the Achema exposition in Frankfort. Details of the proposed itinerary are not yet available, but will be supplied later to readers of *Chem. & Met.* on request to the editorial offices on the 24th floor at 330 West 42d St., New York City.

Slogan Contest Planned For Chemical Show

THE Sixteenth Exposition of Chemical Industries, which will be held at Grand Central Palace, New York, Dec. 6-11, will require three floors. Indications at this early date point to an exposition in which the role of chemical industries in the reconstruction period now under way will be emphasized through the medium of dynamic displays designed to show the coordination of each phase of chemical manufacture with the many industries to which it is related.

A feature of the exposition will be a prize competition for a slogan typifying the role of chemical industries in modern life. The slogan will be expected to represent accurately the purposes of the chemical industries and the benefits accruing to mankind from their activities. Details of the slogan contest will be announced at an early date.

Electrochemists Will Hold Four-Day Session

THE general program for the Spring Meeting of the Electrochemical Society, Inc., which will be held at the Hotel Benjamin Franklin, Philadelphia, April 28-May 1, has been carried almost to completion by the local committee of which Dr. Hiram S. Lukens is chairman. The program calls for registration on the morning of April 28, followed by a meeting of the board of directors and the annual business meeting of the society.

On Thursday morning April 29, the session on "Electrochemical Methods in Biology" will be held with Dr. Duncan A. MacInnes presiding. In the afternoon there will be a session on "Electrode Phenomena in Aqueous Solutions." In the evening there will be group dinners followed by a popular lecture, open to the public, delivered by Dr. Detlev W. Bronk.

Friday morning, April 30 will be devoted to visits to the plants of the Edward G. Budd Mfg. Co., and the Leeds and Northrup Co. After these plant visits the party will return to the Hotel Benjamin Franklin where the Leeds and Northrup Co. will act as host at luncheon.

On Saturday, May 1, Dr. Carleton Ellis will preside at a session on "Industrial Catalysis." The luncheon speaker will be Dr. H. C. Rentschler who will speak on "Photo Cells" and a technical session will continue throughout the afternoon with electro-organic and miscellaneous papers providing the topics.

American Cyanamid Acquires H. A. Metz & Co.

THE American Cyanamid & Chemical Corp. announces the acquisition of the business of H. A. Metz & Co., Inc., of Newark, N. J., as of March 1, 1937. The business of H. A. Metz & Co., Inc., will be consolidated with that of the American Cyanamid & Chemical Corp. and operated in the latter name. The Metz company has been prominent in the manufacture and distribution of textile and tanning chemicals and specialties. These will be manufactured and distributed as in the past with the added facilities of the American Cyanamid & Chemical Corp. as to research, development and distribution.

Columbia Plans Expansion in School of Engineering

A FIVE-YEAR plan for expanding the physical facilities of the Columbia University School of Engineering at a cost of approximately $2,500,000 is outlined by Dean Joseph W. Barker in his annual report. The program, which calls for the construction of two new buildings, would involve no increase in the engineering student body, Dean Barker said, but would "care for the technical advances which have been made in the various fields of engineering in the past three decades." Provision for future growth would be made by constructing an additional building at some later date.

Tyler Succeeds LeMaistre as A.I.Ch.E. Secretary

FREDERIC J. LEMAISTRE, the executive secretary of the American Institute of Chemical Engineers since 1930 and secretary since 1931, has asked to be relieved of these offices in order to give more attention to personal and consulting interests. He will be succeeded by Stephen L. Tyler, chemical engineer of The Thermal Syndicate, Ltd., of New York, the retiring chairman of the New York Section of the Institute. At the same time it was announced that the organization's headquarters are to be transferred from Philadelphia to New York where adequate space has been secured in the Engineering Societies Building at 29 West 39th St.

Late last year Mr. LeMaistre wrote as follows to Dr. Martin H. Ittner, president of A.I.Ch.E., asking the Council to accept his resignation, preferably not later than March 30: "It has been

Frederic J. LeMaistre

quite obvious to me for some months past that headquarters required the services of a full-time executive secretary. Our gentlemen's agreement called for half of my time. More than this has been required for the smooth running of the Institute. I find there are a number of personal interests needing attention which are now long overdue, all of which requires more rather than less leisure time." In accepting this resignation on behalf of the Council, President Ittner expressed the Institute's high regard for its secretary in these words: "I can assure you that Council has had faith in you which is more strongly evidenced by the fact that you have been renominated Executive Secretary ever since the establishment of this position and the membership has elected you Secretary each year because of the confidence they have had in you."

Stephen L. Tyler

During the seven years of Mr. LeMaistre's secretaryship, membership in A.I.Ch.E. has increased from 873 to 1,473, the number of student chapters from 16 to 47 and local sections from 2 to 9. The annual meeting last November at Baltimore set a record registration of 358 while attendance at the semi-annual meeting in Wilmington in May, 1935, reached 522. Deserving of a well-earned rest, Mr. LeMaistre plans to do some traveling in order to visit a number of his old clients, and probably will not return to serious consulting work until October 1. In the meantime, his Philadelphia address will be Box 12, Union League Club.

The newly appointed secretary and executive secretary, Stephen Leslie Tyler, was graduated from Yale University in 1911. After a year in graduate work in metallurgy and physical chemistry, he took his first job as assistant chemist in the test department of the N.Y.N.H.&H.R.R., resigning in July, 1913, to become assistant engineer with The Thermal Syndicate, Ltd. Since 1916 he has been in charge of all engineering connected with the application of the company's fused silica to chemical plant problems. He designed and developed the Tyler absorption unit which is used in hydrochloric acid plants in this country and abroad. Joining the Institute as a junior member in 1917, he was elected to active membership in 1923. He helped to organize and has served as chairman of the local section in the New York City metropolitan area. A member of the Committee on Admissions and identified with many other Institute activities, Mr. Tyler is thoroughly familiar and well prepared for the duties he is to assume on April 1, when the headquarters are officially transferred from Philadelphia to the Engineering Societies Building in New York.

A.C.S. Will Hold Regional Meeting in Omaha

FOR the first time, Omaha, Nebr., has been selected as the place for holding a Midwest Regional Meeting of the American Chemical Society. The meeting will open on Thursday, April 29 and will continue through the forenoon of Saturday, May 1. Headquarters will be at the Hotel Paxton. A half-day will be devoted to a general program and three half-days to divisional programs including: Agricultural and Food Chemistry with Dr. M. J. Blish, Experiment Station, College of Agriculture, University of Nebraska, as chairman; Biochemistry and Nutrition with Dr. Ellis I. Fulmer, Iowa State College, as presiding officer; Chemical Education and History of Chemistry, under the direction of Dr. Frank B. Dains, University of Kansas; Industrial Chemistry, under the direction of Dr. Edward Bartow, University of Iowa; Organic Chemistry, with Dr. Cliff S. Hamilton, University of Nebraska, as chairman; and Physical Analytical, and Inorganic Chemistry, with Dr. E. Roger Washburn, directing the discussion.

Bulk Packaging Conference Arranged for March 24

THE Seventh Packaging, Packing and Shipping Conference and Exposition, held under the auspices of the American Management Association, will take place on March 23-25 at the Pennsylvania Hotel, New York. The exposition will be open each day of the conference and also on Friday, March 26.

On the morning of March 24, a conference on bulk packaging will be held with R. W. Lahey, American Cyanamid Co., presiding. H. A. Campbell, assistant chief inspector, Bureau of Explosives, New York, will speak on "Regulations for the Transportation of Hazardous Articles." R. H. Everett, secretary, Keystone Varnish Co., Brooklyn, will discuss "Current Problems in The Use and Transportation of Shipping Drums." Mr. Everett will present ten basic problems and discussion from the floor will be led by Norman Babcock, Carbide & Carbon Chemical Corp. J. B. Wiesel, Hercules Powder Co., S. M. Norwood, Electro-Metallurgical Co., C. W. Clark, E. I. du Pont de Nemours & Co., T. P. Callahan, Merrimac Chemical Co., D. G. Stewart, E. I. du Pont de Nemours & Co., M. F. Crass, E. I. du Pont de Nemours & Co., E. D. Thompson, Stevens Metal Products Co., H. W. Lees, Draper Mfg. Co., and T. Thompson, Charles Pfizer & Co.

NEWS FROM WASHINGTON

Washington News Bureau
McGraw-Hill Publishing Co.
Paul Wooton, Chief

SPEED in unionization of industry far greater than Washington anticipated was achieved by Lewis-led C.I.O. during the past month. Observers here interpret this situation in a variety of ways. But almost every analyst concedes that "the trend of the times" was a dominant factor. Business men, recognizing the ascendency of labor in affairs of industry, find it good business to go along peacefully.

The first effect which process industry will feel of these labor developments is expected in higher cost for many materials. No one believes, not even the reformers, that steel, automobiles, textiles, or other commodities made by more fully unionized labor can be produced and sold at the old prices. Fortunately for chemical industry, it is not a large user of these goods. Its employees, therefore, may feel the effect in the cost of living almost as soon as the company purchasing agent notices it in bids on goods bought by the industry.

Chemical Labor

Wage earners in chemical industry have always been well paid and have worked reasonable hours, generally fewer hours at higher rates than any comparable group on the payrolls of contemporary manufacturers. This fact will, however, not deter labor leaders from seeking to unionize and to demand recognition of organized labor.

In the prices for chemicals the element of wages is probably less than for most other industrial commodities. Therefore, a given percentage increase in payroll does not represent as great a percentage increase in total cost as for other types of enterprise. These facts represent a gratifying economic situation, but not one that can be assumed to exempt the managements of chemical process industry from definite responsibility for reappraisal of wage schedules. This group of industries is very definitely on the list of those which must be further organized in order to satisfy C.I.O. leadership. Just how high on the list, it is hard to say, because of the readjustments which have followed the unexpected success with steel.

Inflation?

Industrial commodity prices advanced abruptly during 1933. Contrary to most peoples' understanding no significant further price rise occurred after the summer of 1933 until about mid-year 1936. But within the last six to eight months there have been price advances almost equal to those which occurred in the first six months of the New Deal. Much of this recent advance represents buying abroad or speculative purchases by domestic processors who seek to stock up in anticipation of price rise.

The economists do not call this "inflation." But it has tremendous inflationary influence. It will be used as a basis for the argument that business can now very easily pay the higher wages demanded. It may even become the occasion of much scornful pointing at "profiteers." Here again, chemical industry has not been guilty, but may be dragged into the confused market situation in detriment to its reputation, if not to its purse.

Pricing of Power

The President has asked Congress to establish promptly a temporary agency for pricing and marketing of power from the Bonneville project in Oregon. This matter becomes pressing because generation of energy at this new federal enterprise will begin late in 1937. It is evident from the President's report to Congress that he does not wish this temporary agency to preclude later establishment of a Columbia Valley Authority analogous to T.V.A.

The mid-West dust-bowl drought project represents another regional "new economy" program. Plans for it merely add evidence of the President's intention to substitute regional planning for the old-fashioned mixture of federal power projects with state utility regulation.

T.V.A. continues a problem child. However, the controversy between Chairman Morgan and Utility-Baiter Lilienthal has not prevented a change in industrial power sales policy. T.V.A. has withdrawn its former power schedules which were of interest to the chemical industry (known as A-2 and A-4) and substituted therefor a new joint schedule called C-1. Under this new schedule it is not possible to take the same advantage of low minimum-demand charges, as was formerly possible by simultaneous use of the two separate schedules, one of which related to firm power and the other to seasonal power. The actual cost to prospective users is, however, not greatly changed.

Food and Drug Law

All but a few in Washington believe that the Copeland food and drug bill as reported to the Senate mid-February is a sound workable bit of legislation that would enable the Food and Drug Administration vigorously to prosecute those guilty of adulteration or other improper practice in manufacture or merchandising of foods, drugs, proprietary medicines, and cosmetics, including the advertising of these goods. But someone persuaded the President that this law was rather too weak to be fully effective. His press-conference comment to this effect greatly reduced the chance of early enactment of the bill in the Senate. It also aggravated the controversy in the House, where those who wish advertising to be regulated by the Federal Trade Commission, instead of F. & D. A., will seize on the President's comment to block early action.

Chemical industry will be interested in further developments, but need have little concern regarding this measure as it now stands, even if some of the "strengthening" features are restored as it passes through Congress. It is not at all likely that any measure having the obnoxious and unworkable features of the original Tugwell bill will even get serious consideration, much less enactment into law.

Silicosis Report

Early in February a long-awaited second National Silicosis Conference was held under the auspices of the Department of Labor. Four technical committees reported fully on: engineering control, medical control, economic and legal problems, and regulatory and administrative phases of the silicosis problem. In essence, the Conference concluded that more education on the basis of well-established present knowledge was the great need. But there seemed general agreement also that silicosis should be made a compensable industrial disease under state workmen's compensation laws.

A summary of the four technical reports presented at this Conference is being prepared by the Department of Labor and will be published sometime soon, probably during April, for the information of those who need to safeguard their employees in this particular. Chemical industry executives can procure single copies of this report by addressing the Division of Labor Standards, Department of Labor, and asking for the Silicosis Conference Report.

British Chemical Industry Aided by Key Industry Duties

FROM OUR LONDON CORRESPONDENT

CHEMICAL trade generally in the United Kingdom is satisfactory and the demand for industrial chemicals has been seasonally good. There has been a keen demand for acetic acid, and, following a recent reduction in price by £2 per ton, available supplies were quickly taken up. There has also been a fair demand for sodium chlorate, now manufactured in England on a commercial scale for the first time. The market for acetone is very active and competitive. Potassium permanganate increased in price to the extent of 1½ pence per pound, following the announcement that the imported product would be subject to Key Industry Duty as from Jan. 1. On the recommendation of the Import Duties Advisory Committee, oxalic acid has also become subject to Key Industry Duty, as commercial production in the United Kingdom has now become substantial enough to take care of a 9000 part requirements.

The outstanding advance in the price of refined glycerine also calls for comment. This product has increased by £35 per ton since "the rising values of oils and fats, the premium on open market supplies of crude glycerine, and the general international shortage of glycerine compelled the industry to depart from the levels to which the refined product had been keyed since the end of August 1935." The first increase of £10 per ton was announced on Nov. 27, 1936; a second rise of £10 came on Dec. 22, 1936; and the remaining advance of £15 has taken place since the turn of the year. This increase will be felt most severely by a growing body of users, among whom are the makers of glyptal synthetic resins and ester gums. The glyptal resin industry, it may be added, is also troubled by the higher price which is demanded for phthalic anhydride, as a consequence of the scarcity of refined naphthalene in the United Kingdom.

At the time of writing, manufacturers and merchants are expecting a notable stimulus to export trade in chemicals as a result of the annual British Industries Fair which opens in London and Birmingham during the third week of February.

British Foreign Trade in Chemicals

Exports of home-produced chemicals and allied products from the United Kingdom appear to be steadily improving. With a slight spurt during December, 1936, the total value for the year was £21,100,000. By comparison with 1935 this total was lower to the extent of £229,000, but £490,000 better than 1934. There were no outstanding changes in the relative importance of the most prominent markets. British India continued to hold its position as the greatest user of British chemicals, although exports in this direction actually decreased from £2,882,000 to £2,351,000, whereas exports to Australia, the next best market, increased from £1,770,000 to £1,855,000. Canada, with a total of £1,235,000, was also a better customer in 1936. Exports to the United States were distinctly better at a total value of £1,025,000, by comparison with £700,000 during 1935, most probably due to the higher prices received for coal-tar products as well as the larger quantities involved.

Imports of chemicals and allied products into the United Kingdom during 1936 were valued at £12,584,000, which was £983,000 more than in 1935. As in previous years about 50 per cent of the imports in terms of value came jointly from Germany and the United States, products of German origin being roughly twice the monetary value of those from the United States. Increased imports were recorded for lithopone and sodium cyanide, although there are adequate manufacturing facilities for both products in the United Kingdom. There were also notable increases in the case of carbon black, potash fertilizers, quebracho extract, and other products with no competitive source of United Kingdom origin.

Plant Developments

The British Oxygen Co. has recently revived its plans for the development of a large hydro-electric scheme in the Highlands of Scotland, with the erection of a factory for the manufacture of calcium carbide at Fort William. When first put forward, the scheme was rejected by Parliament in March 1936, but it is understood that objections then raised regarding rating relief and land purchase have now been adjusted. If the scheme develops carbide will become available in the United Kingdom in sufficient quantity and at prices low enough for economic utilization of acetylene in the manufacture of organic chemicals, on similar lines to the industry at Shawinigan Falls in Canada. The establishment of such an industry in the United Kingdom, however, could not possibly proceed as rapidly as it did in Canada, where only fourteen months elapsed between the laboratory investigation and the full capacity operation of a plant covering 15 acres, owing to the additional work involved in concentrating the available hydro-electric power resources. At present imports of calcium carbide average about 4,000 tons per month, of which nearly 60 per cent comes from Norway.

National Oil Refineries Ltd., a subsidiary of the Anglo-Iranian Oil Co., which operates the Llandarcy works near Swansea, is starting upon a large plant improvement and extension scheme. A contract has been placed for a combined atmospheric and vacuum distillation unit to deal with 10,000 barrels of crude oil per day. This unit will supersede the existing primary distillation units; simultaneously it will provide the secondary or vacuum stage for producing lubricating oil base stocks. The plant will comprise continuously operating pipe still heaters, coupled to fractionating columns and condensers, and will be fueled by the aid of chain grate stokers fed with local coal, with the addition of a thermostatically controlled oil burner to give the fine temperature control which is essential but not obtainable from coal burning by itself. Supplementary contracts are to be placed for solvent dewaxing plant and for high temperature oily treatment plant for lubricating oils. It is expected that the plan will be completed by June, 1938.

A new refinery which will specialize in the production of high quality solvent-refined lubricating oils, and other petroleum products, is to be erected at Trafford Park, Manchester, by Manchester Oil Refinery Ltd., recently registered as a private company with an authorized capital of £250,000, of which £200,000 has been paid in.

Hull, on the east coast of England, is showing increased industrial activity of a chemical aspect. A codliver oil refinery which was established only eighteen months ago has now built up a turnover in excess of the total production of Norwegian codliver oil. The whole of the fishing fleet which cooperates with the refinery has been reequipped to produce crude fish oil at sea in order to feed the refinery with a steady flow of raw material in its best possible condition. Fertilizer production is also becoming important at Hull, the 1936 output being 10 per cent greater than that recorded for 1935.

Imperial Chemical Industries continues to produce new pigments and dyestuffs. Its most recent products include a range of blue shades based on Monastral Fast Blue BS, the discovery of which was an outstanding event in the dyestuffs industry about a year ago.

New Shatter-Proof Glass Produced In Germany

FROM OUR GERMAN CORRESPONDENT

AN industrial improvement campaign as part of Germany's four-year plan was carried out in all chemical factories from Dec. 1 to March 1. Employees were asked to offer practical suggestions in a contest for the solution of the following eight problems in their respective plants: how to save materials, how to reduce waste, how to utilize waste, how to improve tools and equipment, how to prevent accidents, how to combat industrial diseases, and how to beautify the plant and its surroundings. For the best written proposals handed in, prizes will be awarded in each plant on May 1, Germany's national labor holiday.

The Rheinisch-Westfaelische Kalkwerke, Dornap, Germany's largest manufacturers of lime, controlled 78 per cent by the Stahlverein and Hoesch, has just declared 6 per cent dividends. The firm reported an increased turnover for 1936, mainly as a result of the increased demand of the two above-named steel concerns and of I. G. Farben. Sales of lime for agricultural and building purposes were less favorable.

That Saar coal is suitable for large-scale synthetic motor fuel production was stated before the annual German mining congress by Dr. Waechter, chairman of the Saar mine administration, who reported on the experimental operations in the Saar Heinitz coking plant. He also mentioned that not much coal is being coked, although two-thirds of the Saar coal is cokable.

The electro-static method of charging dust and smoke particles electrically and attracting them on condenser plates, as developed by the Kaiser Wilhelm Institute, is being applied extensively in German factories, among others in the smokestack-less Leverkusen power plant of I. G. Farben (*Chem. & Met.*, December). It has been reported that through this method last year in one German factory 875,000 tons of lignite dust, which would otherwise have flown uselessly into the air was recovered and briquetted.

For several years the Roechling Völklingen plant in the Saar has been successfully making iron and steel from dust recovered in a similar manner from chimneys of blast furnaces.

The largest German synthetic motor fuel undertaking has just been founded as the Gelsenberg Benzin A.G. with a capital of 110 million marks. The new undertaking is being backed by the Gelsenkirchener Bergwerks A.G., the largest coal owner in Germany, which furnishes all the coal for the Vereinigte Stahlwerke. The new company is being financed differently than the past synthetic plants. Of the 110 million marks, 50 million represent capital stock, 5 million reserves, and 55 million a 9 year bond issue. The money is put up partly by the coal concern, partly by banks, and the 5 per cent bond obligations, which are open to public subscription, are guaranteed by the steel concern. Formerly the "Brabag" (Braunkohlen Benzin A.G.) was the largest enterprise, with a capital of 100 million marks.

To aid consumers with the large number of new plastic materials coming on the market, the German Norm Committee has issued norm specifications (Normblatt 7701) for five types of synthetic resins (four phenoplasts and one aminoplast), setting up standard mechanical and thermal as well as chemical requirements.

New Shatter-Proof Glass

Shatter-proof glass with an organic instead of silicate base is being manufactured successfully by Roehm and Haas, Darmstadt. In the past, multi-layered safety glass with thin intermediary layers of celluloid film, cellulose acetate film, and recently with polymerized film, was developed to take the splinter-danger from ordinary silicate glass. The new organic so-called "Plexiglass," based on polymerized methyl ester and abandoning the silicate foundation, promises new uses. The esters of methacrylacid (CH_2:$C(CH_3)$.COOH) are colorless liquids, which through polymerization can be made to harden into bubble-free transparent glass in any desired thickness up to two inches. "Plexiglass" is impervious to air and rain and acids, although certain organic materials, acetic esters, benzol, chloroform and alcohol dissolve it. Since gasoline, oils, fats, wax, and destructive bacteria do not affect the glass, however, it is useful for filtering and conducting substances which should not come into contact with metal or wood, and faucets and tubing can also be made of the material. An interesting use of "Plexiglass" has been in the construction of models of blood vessels of human beings and animals by filling the vessels with a special solution of "Plexiglass," marketed under the trade name of "Plastoid," which polymerizes when heated to 50 to 60° C. and retains the exact form of the original model, which is later dissolved and removed.

The physical and chemical properties of "Plexiglass" make it suitable for use in airplanes and automobiles. Its specific weight is only 1.18 compared with silicate glass with 2.6, which in the case of four square yards of window panes in a large passenger airplane means a saving of 50 pounds over silicate glass of equal thickness. Tests with $\frac{1}{8}$ to $\frac{1}{4}$ inch thicknesses of organic glass and regular glass show that "Plexiglass" can stand 8 to 10 times the blows of silicate glass before breaking. When it does crack, it does not splinter but breaks into a few large pieces, whose edges are not sharp; this safety feature makes it desirable for use as automobile windshields. The new glass, although not quite as hard as silicate glass, may be used for optical purposes and does not become yellow and is not easily scratched. An additional advantage is that it may be tooled like wood and metal; it can be cut, carved, etched, engraved, turned, ground, and polished, and two pieces can even be welded together without leaving a seam.

CALENDAR

AMERICAN CHEMICAL SOCIETY, semi-annual meeting, Chapel Hill, N. C., April 12-15.

ELECTROCHEMICAL SOCIETY, seventy-first general meeting, Philadelphia, Pa., April 28 to May 1.

THIRD DEARBORN CONFERENCE OF AGRICULTURE AND INDUSTRY, Detroit and Dearborn, Mich., May 25-27.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, semi-annual meeting, Toronto, Canada, May 26-28.

AMERICAN PETROLEUM INSTITUTE, mid-year meeting, Colorado Springs, Colo., June 1-3.

WORLD PETROLEUM CONGRESS, Paris, France, June 14-19.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Waldorf-Astoria Hotel, New York City, June 28 to July 2.

16TH CHEMICAL EXPOSITION, Grand Central Palace, New York City, December 6-11.

C. R. Johnson

James T. Gow

James G. Marshall

PERSONALITIES

J. FRANK ANDERSON, vice-president of the Haveg Corp. and for the past two years active head of that subsidiary of the Continental-Diamond Fibre Co., has been named assistant to Pres. J. P. Wright of the parent company. Mr. Anderson will have charge of factory operation and maintenance. He will also continue as vice-president of the Haveg Corp.

FREDERICK S. BACON, for seven years chemical engineer for the Boston Blacking and Chemical Co., Cambridge, Mass., resigned that position to join the staff of Gustavus J. Esselen, Inc., chemical consultants of Boston, Mass. Mr. Bacon is well known for his engineering developmental work in the fields of dyes, finishes, adhesives and lacquers.

RICHARD F. BARNES, JR., is now serving on the technical staff of the International Nickel Co., New York, N. Y. He specializes in problems involving resistance to metallic corrosion.

P. J. BYRNE, JR. has been transferred from the Aruba refinery of the Standard Oil Development Co. to serve as assistant chief process engineer of the process engineering division of the same company at Bayway, N. J. P. E. Kuhl has been appointed assistant manager of the process department.

HARALD DJORUP, chief chemist of the Greenwich plant of the Pennsylvania Salt Mfg. Co., Philadelphia, is retiring from active duty after 47 years of service. Mr. Djorup will continue with the company in an advisory capacity.

GUSTAV EGLOFF, director of research for Universal Oil Products Co., has accepted an invitation to head a committee to arrange a program on refining for the World Petroleum Congress to be held in Paris, June 14 to 19.

A. J. FISCHER, development engineer for the Dorr Co., Inc., of New York City, was the recipient of this year's Kenneth Allen Memorial Award. The award is given by the New York State Sewage Works Assn. in recognition of the best research paper delivered before the Association during the year.

HOWARD E. FRITZ, formerly chemical sales manager of The B. F. Goodrich Co., mechanical goods division, has been named manager of Koroseal sales and development. Dr. Fritz came to Goodrich in 1925 from the chemistry faculty of Ohio State University.

PER K. FROLICH, chief chemist for the Standard Oil Development Co., has been appointed head of that company's newly formed chemical laboratories at Bayway, N. J.

WAYNE R. FULLER has resigned as technical director of Pratt & Lambert, Inc., Buffalo, to become manager of industrial research for Devoe & Raynolds Co., Inc., Louisville, Ky.

CARL H. GEISTER, until recently with the Mellon Institute of Industrial Research in Pittsburgh, has joined the technical laboratory staff of the dyestuffs division of E. I. du Pont de Nemours & Co., Wilmington, Del.

JAMES T. GOW is a new member of the staff of Battelle Memorial Institute, Columbus, Ohio. His work is in metallurgical research, particularly in the fields of heat and corrosion resistant alloys. After graduating from the University of Minnesota in 1929 Mr. Gow entered the employ of the Naval Research Laboratory, where he was identified with the development of the gamma ray method of inspection of steel castings. He has lately worked as a research metallurgical engineer with the International Nickel Co.

HAROLD P. GREENWALD has been appointed supervising engineer of the Pittsburgh Experiment Station of the U. S. Bureau of Mines.

WILLIAM F. HOLBROOK, assistant chemical engineer at the Bureau of Mines, and THOMAS L. JOSEPH of the faculty of the Minnesota School of Mines and Metallurgy, were joint recipients of the A.I.M.E.'s 1937 Robert Woolston Hunt Prize for contributing the "best original paper on iron and steel during 1936."

C. R. JOHNSON has been appointed technical director of the newly organized Witco Carbon Co., New York City. Mr. Johnson has had extensive experience in the rubber and carbon black industries. For a number of years he was with the Goodyear Tire & Rubber Co. serving as chief chemist and later as manager of development. More recently he was technical director of Godfrey L. Cabot, Inc., manufacturers of carbon black.

CHARLES H. LINDSLEY, who for the past two years has been connected with

C. E. MacQuigg

Franklin Institute in Philadelphia, has been added to the technical staff of the International Nickel Co.'s research laboratory at Bayonne, N. J. He will specialize in the application of physico-chemical methods to the study of corrosion.

A. T. LOEFFLER, who became associated with Monsanto Chemical Co. in a sales capacity several months ago, has been appointed assistant manager of Monsanto's eastern district office in New York City. Mr. Loeffler was formerly with Hooker Electrochemical Co.

C. E. MACQUIGG, for many years research metallurgist with the Union Carbide & Carbon Corp., has been named dean of engineering of the Ohio State University. Mr. MacQuigg will assume his new duties at Columbus about July 1. In his new capacity he will also be ex-officio director of the Engineering Experiment Station of the University and will be identified with the research work to be done under the newly organized Ohio Engineering Research Foundation. This organization has been set up to facilitate cooperation between the University and the industries of the State in the conducting of research in Columbus.

JAMES G. MARSHALL, general superintendent of the Niagara and Welland plants of Union Carbide Co. and Electro Metallurgical Co., has been named to receive the Schoellkopf Medal for 1937 from the western New York section of the American Chemical Society. Mr. Marshall's work in the technical development of the carbide and allied industries was cited in announcing the award.

F. L. MILLER, formerly in charge of lubricants research at the Esso Laboratories, Bayway, N. J., has been made assistant director of that organization.

J. EDGAR PEW, vice-president of the Sun Oil Co., received the Anthony F. Lucas Medal "for distinguished achievement in improving the technique and practice of finding or producing petroleum" at the annual meeting of the A.I.M.E. held recently in New York City.

DONALD PRICE has joined the research staff of the National Oil Products Co., Harrison, N. J. Dr. Price was a member of the chemistry faculty of Columbia University for a number of years.

JEROME S. ROGERS has joined the staff of the Bureau of Chemistry and Soils, U. S. Department of Agriculture, as research chemist on tanning materials and leathers. He comes to this new position from the International Shoe Co. where he was in charge of the control and research laboratories of the sole leather department.

HELMUTH H. SCHRENK has been appointed chief chemist of the Health Division of the U. S. Bureau of Mines, and will have his headquarters at the Bureau's Pittsburgh experiment station. In his new position Dr. Schrenk succeeds William P. Yant, who recently resigned to accept the directorship of research for the Mine Safety Appliances Co.

FOSTER DEE SNELL has resigned as Honorary Secretary of the American Section of the Society of Chemical Industry. Dr. Snell has ably performed the duties of this office for over eleven years and will be succeeded by Cyril S. Kimball. Dr. Snell is president of Foster D. Snell, Inc., a firm of consulting chemists and chemical engineers located in Brooklyn, N. Y.

Frederick S. Bacon

H. V. STOHL, formerly ceramic engineer in charge of production and research at the Wisconsin Porcelain Co., Sun Prairie, Wis., has joined the Line Material Co., Milwaukee, as ceramic research engineer.

CLYDE L. THOMPSON has resigned from the faculty of the department of ceramic engineering, University of Illinois, to accept a position on the research staff of the Harbison-Walker Refractories Co.

CHARLES S. WILLIAMSON, JR. of the department of chemistry of Tulane University has been elected president of the Louisiana Engineering Society, New Orleans.

J. P. WRIGHT, president of the Continental-Diamond Fibre Co., Newark, Del., has added to his former executive responsibilities those of general management of the manufacturing division of the company. Assisting Mr. Wright will be J. Frank Anderson (see opposite page), Robert Stewart in charge of production, and G. E. Landt as technical director.

OBITUARY

WILLIAM PITT MASON, retired head of the department of chemical engineering and chemistry at Rensselaer Polytechnic Institute and one of the country's pioneers and leaders in sanitary engineering, died Jan. 25 at his home in Little Boar's Head, N. H. "Uncle Billy" Mason was one of the Charter Members of the American Institute of Chemical Engineers.

CHARLES PAGE PERIN, well-known iron and steel consulting engineer and president of the firm bearing his name, died Feb. 16 in New York City. Dr. Perin built one of the first plants in the United States for the manufacture of pure iron by electrolysis.

CRANDELL Z. ROSECRANS, director of the research department of Leeds & Northrup Co., Philadelphia, died Jan. 7 in St. Louis after a short illness.

JOHN BRADSHAW TAYLOR, assistant to Dr. Irving Langmuir in the research laboratory of the General Electric Co., died Jan. 22 in Schenectady, N. Y. Dr. Taylor was a member of Sigma Xi and the American Chemical Society.

LESTER WITTENBERG, executive vice-president of the Barrett Co., died Jan. 18 in New Rochelle, N. Y. Mr. Wittenberg was an important factor in the development of tar road materials and specification roofings.

Chemical ECONOMICS

VOLUME of industrial production, which usually increases in January, declined from December to January and as a result the Federal Reserve adjusted index was 115 in January, compared with 121 in December and with 97 in January 1936, according to a summary of general business conditions in the United States compiled by the Federal Reserve System.

Steel production increased, though by less than the usual seasonal amount, and was larger in January than at any other time during the recovery period. In the first three weeks of February output of steel increased somewhat further.

Output of automobiles, although large, was curtailed by strikes in January and the first half of February, but after the strikes were settled production rose sharply. There was a considerable decrease in activity at lumber mills in January, reflecting in part the effects of unusually cold weather in the western lumber regions. Plate glass production declined further in January but toward the end of the month the strikes, which had restrained output since October, were settled.

The outlook for most branches of the chemical-producing and chemical-consuming industries is regarded as very favorable. The glass industry was adversely affected in the latter part of last year and in the opening weeks of this year but the plants which had been closed have been getting into full production as fast as possible and with a heavy backlog of orders it will be necessary to maintain output at a high level before it will be possible to build up normal inventories in the hands of producers and consumers.

Sulphuric acid started the year in the best position it has occupied in a number of years. This followed as a result of large consumption in 1936 which not only took up the greater part of production but also drew heavily upon surplus stocks and a scarcity of acid was reported in some sections of the country. The strong statistical position points to an enlarged domestic production this year with a corresponding gain in sales of such materials as sulphur and pyrites.

Fertilizer sales so far this season have been running considerably above those for the corresponding period of last year. An increase of close to 10 per cent is indicated in the total fertilizer tonnage for the year. Prices for raw materials are higher than they were a year ago but the finished products also are higher and selling promises to be free from widespread price-cutting tactics.

With enlarged production schedules for the automotive trade and with a healthy revival of building operations in prospect, the paint and varnish industry is almost certain to create a new record for the sale of its products.

Total net sales and collections on accounts receivable showed substantial improvement during January 1937 for the group of manufacturers reporting in the monthly joint study of the National Association of Credit Men and the Bureau of Foreign and Domestic Commerce. This is a continuation of the gains in sales and higher rates of collections recorded for each month of 1936 as compared with the same month in 1935 by this group of manufacturers.

The total net sales of the 513 manufacturers throughout the country reporting in January 1937 registered an increase of 22 per cent from January 1936. Without adjustment for seasonal influences, January 1937 sales registered a decrease of approximately 3 per cent from December of last year.

Total sales increased in January 1937 over the same month last year for all of the 15 industry groups shown in the report except petroleum products. The increases ranged from 15.3 per cent for printing and publishing to about 50 per cent for iron and steel and their products. The increases in January 1937 sales over January 1936 for stone, clay and glass products; machinery; and non-ferrous metals and their products also were high, the increases exceeding 40 per cent.

Percentages of collections on accounts receivable submitted by 459 manufacturers were higher for January 1937 than for January a year ago but under December last year. During January this year the manufacturers reporting collected 78.1 per cent of their accounts receivable outstanding on the first of that month as compared with 75.6 per cent collected during January and 80.4 per cent collected during December of last year.

The January 1937 percentage changes for some of the groups are shown as follows:

	Percent of change from Jan. 1936	Percent of change from Dec. 1936
Food products	18.4	7.1*
Textiles	17.1	5.7*
Paper and products	15.7	1.2
Chemicals	23.7	6.1
Paint and varnish	32.2	33.1
Pharmaceuticals	18.0	0.4
Petroleum products	9.0*	8.8*
Rubber products	34.6	16.4
Leather products	18.0	30.7
Stone, clay and glass	50.8	7.2*

* Represents percentages of decline. All other numbers represent percentages of increase.

Preliminary reports from manufacturers of lithopone indicate that 160,700 tons of this product was sold in 1936, the largest annual quantity since 1930. In 1935, 159,486 tons were sold. The relatively small increase in 1936 over 1935 is due in part to a change in the method of compiling statistics. Formerly the combined weights of standard grade and high strength lithopone were reported as total sales. Beginning with 1936 the total will include sales of standard grade plus the standard grade equivalent of the high strength product. Thus the new series of statistics differs from the old series by the excess quantity of zinc sulphide contained in high strength lithopone.

With improvement of economic conditions throughout the larger part of the world, the outlook for chemicals and related products in 1937 is the best in years, say experts of the Chemical Division, Department of Commerce.

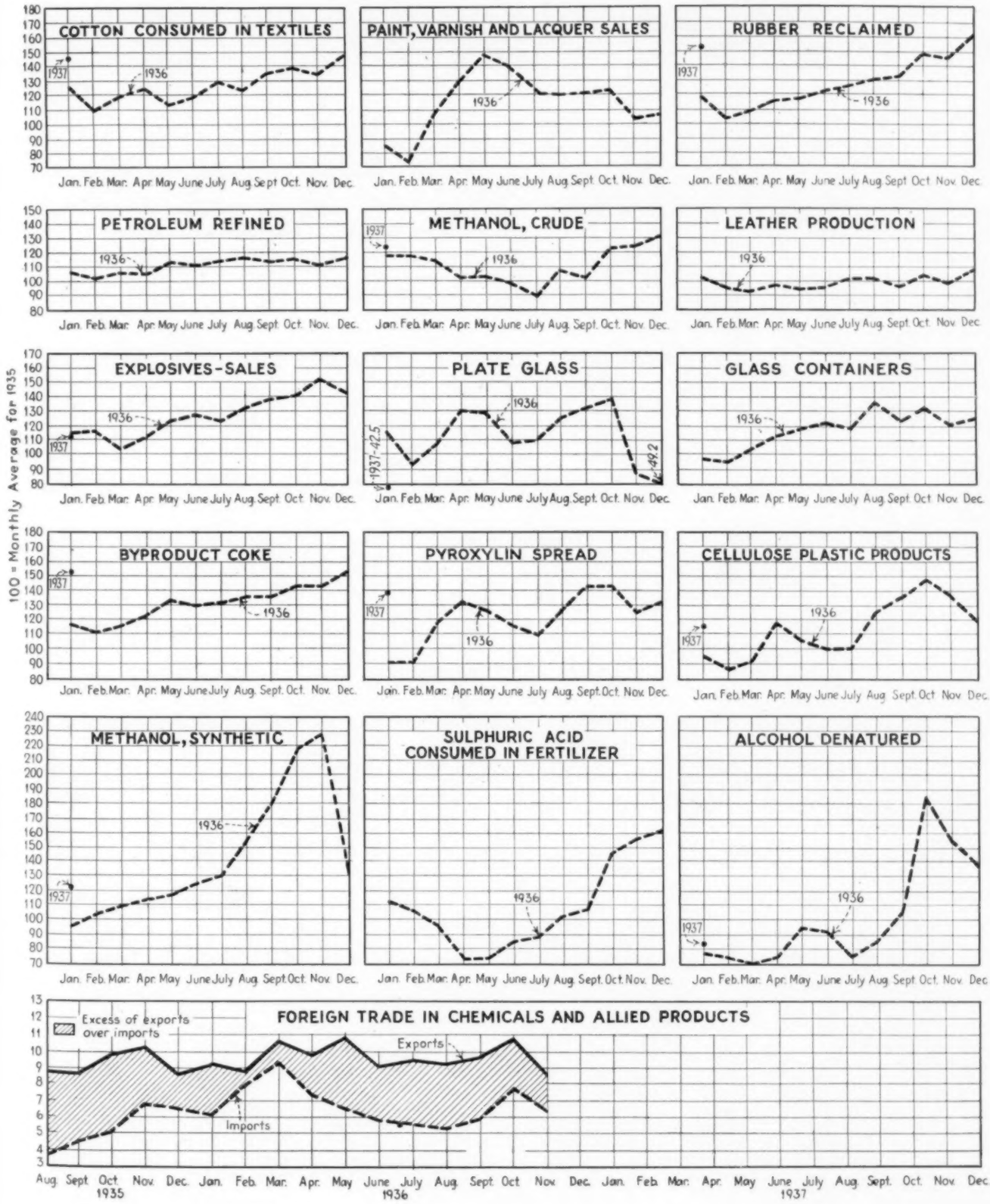
Demand for American chemicals continues to expand steadily, they assert, and the result of this is apparent in the flood of inquiries from the industry's executives, sweeping into the Washington office of the division.

These inquiries cover a broad field, and are said to indicate that American chemical producers are alive to the opportunities presented abroad as well as possibilities for development of the domestic markets.

Inquiries show that sharp lookout is being maintained for new lines of manufacture, with chemical market research showing marked signs of increased strength and alertness. This applies both to old and new lines, and to raw materials and finished products, say officials of the Division.

The officials point to the exports of chemical products in 1936 with a total of more than $154,000,000, with such new products as plastics, synthetic resins, heating and refrigerating gases, gaining positions of importance.

TRENDS OF PRODUCTION AND CONSUMPTION



The MARKETS

THE various industries which are large consumers of chemicals have been taking delivery of raw materials in a large way. Glass makers are again in active operation and consumption of chemicals in that industry for the first half of this year is expected to reach record proportions. Fertilizer mixers also are reported to have consumed unusually large amounts of chemical products in the last month and the same is true for the automotive industry. In fact, practically all consuming industries are in a position where their raw material requirements are running to large totals.

The price trend during the month was upward with chemicals which depend on a metal base leading the way. Antimony oxide is quoted only as nominal. Lead carbonate has been marked up a full cent a pound with lead oxides going up still faster. Stocks of copper sulphate are low and higher production costs are pushing sales schedules upward. While no change has taken place in the schedule for zinc oxide, it is probable that higher prices will be in effect on deliveries for the second quarter of the year.

Among the important changes in prices was the announcement that effective March 1, a lower schedule would be in effect on single shipments of ethyl cellulose. The new prices quote 65c. a lb. for a carload of 16,000 lb. and range upward to $1.00 a lb. for 1 lb. to 10 lb. samples.

Vegetable oils and animal fats also showed a higher average price level for the month but the large stocks of lard—which are steadily increasing—is acting as a check and may weaken prices for cottonseed oil which in turn would have a depressing effect on values for some of the other oils.

Acetate of lime is finding a ready market with a firm price tone. The census figure for 1935 gives production as 25,846 tons. This is in terms of 80 per cent strength. In previous census returns, the strength was not specified. Production was reported at 25,796 tons and 58,163 tons for 1931 and 1929 respectively.

Among developments in foreign chemical markets as reported by the Department of Commerce are:

Efforts are being made in Cuba to revive the demand for Chilean nitrate, according to reports from Habana. A lot of 200 metric tons were imported during January, a quantity greater than that brought in during any of the past several years, analysis of Cuban import statistics indicate. Until six years ago Chilean nitrate was sold in considerable quantities in the Cuban market.

Italy which is dependent upon foreign countries for its potash requirements is reported to have discovered a large deposit of potash salts in Sicily. Efforts to produce soluble potash from leucite deposits near Rome have been abandoned as uneconomic.

Depreciation of the Dutch guilder with consequent increases in prices of imported synthetic dyes into Netherland India has resulted in a marked revival in domestic indigo cultivation. Native batik makers of that country use considerable quantities of indigo.

Hungary began production of sulphur in October of last year. Officials of the company state that owing to the low sulphur content of raw materials being used not more than 2,500 tons are expected to be produced during the current year.

Preliminary statistics covering sales of lead and zinc pigments in 1936 indicate that manufacturers of these products enjoyed their best year since 1929.

Sales of litharge, according to the Bureau of Mines, were at record levels in 1936, the total for the year exceeding the previous record for 1929 by 9 per cent and exceeding sales in 1935 by 20 per cent. Sales of white lead (dry and in oil) and of red lead were the largest recorded since 1929 and were 20 and 17 per cent, respectively, greater than those for 1935. Little change was made in the rate of sales of basic lead sulphate and of orange mineral in 1936.

New high records were established for sales of leaded zinc oxide and zinc sulphate in 1936. Totals for these products were 32 and 17 per cent, respectively, above the totals for 1935. Sales of zinc oxide in 1936 were 30 per cent higher than in 1935 and were the largest recorded since 1929.

All of the lead and zinc pigments reached low points of the depression in 1932. The more important pigments have made the following percentage recoveries from that year: Leaded zinc oxide 176, zinc oxide 79, red lead 78, white lead (dry and in oil) 74, litharge 65. Tonnages sold in 1932 were lower than in 1929 by the following percentages: Red lead 56, zinc oxide 55, white lead 55, leaded zinc oxide 47, lithopone 41, and litharge 34. It is significant that in general the greatest improvement in 1936 over depression lows was made by pigments that suffered the largest declines in depression years.

It is reported that the Mathieson Alkaline Works plans the erection of a large chlorine plant, probably at Lake Charles, La. Growing demand for chlorine in the South, especially as a bleaching agent in kraft paper plants, explains the advantage of local production.

Consumption of Zinc Dust

On page 81 of our February, 1937, issue an error has been found in the figure given for the 1935 consumption of zinc dust in the organic chemicals industry. The figure should have been 10,250 tons instead of 20,500 tons. The error consisted in not converting to tons, the reported total which was given in pounds.

CHEM. & MET. Weighted Index of CHEMICAL PRICES

Base = 100 for 1927

This month	87.79
Last month	87.19
March, 1936	87.15
March, 1935	87.63

Sharp advances were reported for most of the metal salts including copper sulphate, lead carbonate, lead oxides, and tin salts. Antimony oxide is nominal in price. Spirits of turpentine held a lower average level during the month. The majority of heavy chemicals were steady in price.

CHEM. & MET. Weighted Index of Prices for OILS AND FATS

Base = 100 for 1927

This month	108.84
Last month	104.60
March, 1936	85.48
March, 1935	99.02

Higher prices were again in effect with this holding true for crude cottonseed, linseed, coconut, China wood, menhaden, and olive oil foots. Tallow also closed above the price levels of a month ago with some indication that animal fats would ease off.

Current PRICES

The following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 13

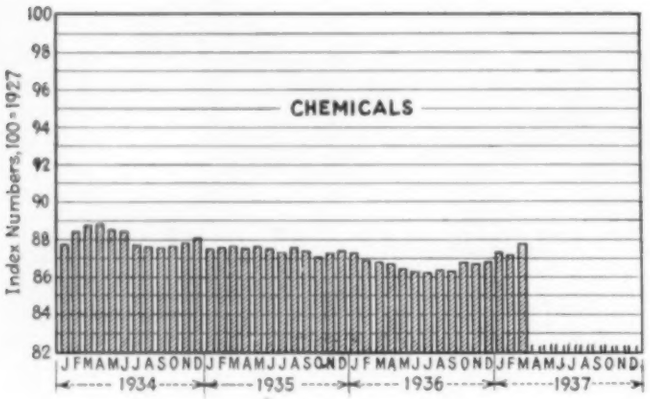
Industrial Chemicals

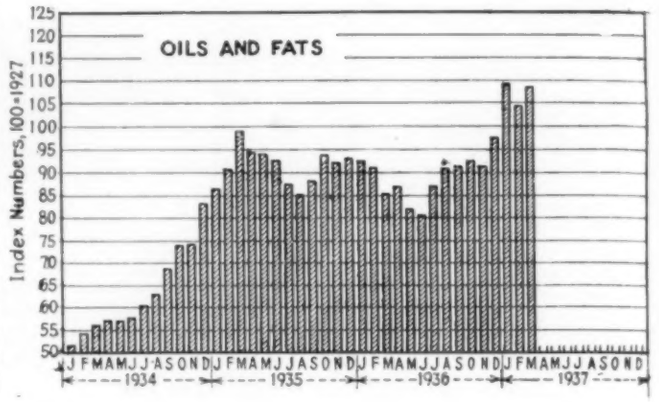
	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.07 -$0.08	$0.07 -$0.08	$0.10½-$0.11
Acid, acetic, 28%, bbl., cwt.	2.25 - 2.50	2.25 - 2.50	2.45 - 2.70
Glacial 99%, drums	8.43 - 8.68	8.43 - 8.68	8.43 - 8.68
U. S. P. reagent	10.52 -10.77	10.52 -10.77	10.52 -10.77
Boric, bbl., ton	105.00-115.00	105.00-115.00	105.00-115.00
Citric, kegs, lb	.25 - .28	.25 - .28	.28 - .31
Formic, bbl., ton	.11 - .11½	.11 - .11½	.11 - .11½
Gallic, tech., bbl., lb	.60 - .65	.60 - .65	.60 - .65
Hydrofluoric 30% carb., lb	.07 - .07½	.07 - .07½	.07 - .07½
Lactic, 44%, tech., light, bbl., lb.	.06½- .06¾	.06½- .06¾	.11½- .12
Muriatic, 18°, tanks, cwt.	1.00 - 1.10	1.00 - 1.10	1.00 - 1.10
Nitric, 36°, carboys, lb	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -.....	18.50 -20.00
Oxalic, crystals, bbl., lb	.10½- .12	.10½- .12	.11½- .12½
Phosphoric, tech., c'bys., lb.	.09 - .10	.09 - .10	.09 - .10
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Sulphuric, 66°, tanks, ton	15.50 -.....	15.50 -.....	15.50 -.....
Tannic, tech., bbl., lb	.20 - .30	.20 - .30	.23 - .35
Tartaric, powd., bbl., lb	.21½- .22½	.21½- .22½	.24 - .25
Tungstic, bbl., lb	1.50 - 1.60	1.50 - 1.60	1.50 - 1.60
Alcohol, Amyl	-.....	-.....	-.....
From Pentane, tanks, lb.	.123 -.....	.123 -.....	.15 -.....
Alcohol, Butyl, tanks, lb	.08½-.....	.08½-.....	.11 -.....
Alcohol, Ethyl, 190 p'f., bbl., gal.	4.14 -.....	4.14 -.....	4.27½-.....
Denatured, 190 proof			
No. 1 special, dr., gal wks.	.32 -.....	.32 -.....	.33 -.....
Alum, ammonia, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Potash, lump, bbl., lb.	.03 - .04	.03 - .04	.03 - .04
Aluminum sulphate, com bags cwt.	1.35 - 1.50	1.35 - 1.50	1.35 - 1.50
Iron free, bg., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Aqua ammonia, 26°, drums, lb.	.02½- .03	.02½- .03	.02½- .03
tanks, lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Ammonia, anhydrous, cyl., lb.	.15½- .16	.15½- .16	.15½- .16
tanks, lb.	.04½-.....	.04½-.....	.04½-.....
Ammonium carbonate, powd. tech., casks, lb	.08 - .12	.08 - .12	.08 - .12
Sulphate, wks., cwt.	1.35 -.....	1.35 -.....	1.25 -.....
Amylacetate tech., tanks, lb	.11 - .11½	.11 - .11½	.12 -.....
Antimony Oxide, bbl., lb	.16 - .16½	.14 - .14½	.14½- .14
Arsenic, white, powd., bbl., lb.	.03 - .03¾	.03 - .03¾	.03¾- .04
Red, powd., kegs, lb	.15½- .16	.15½- .16	.15½- .16
Barium carbonate, bbl., ton	56.50 -58.00	56.50 -58.00	56.50 -58.00
Chloride, bbl., ton	72.00 -74.00	72.00 -74.00	72.00 -74.00
Nitrate, cask, lb	.08½- .09	.08½- .09	.08½- .09
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Bleaching powder, f.o.b., wks., drums, cwt	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, gran., bags, ton	44.00 -49.00	44.00 -49.00	44.00 -49.00
Bromine, cs., lb	.36 - .38	.36 - .38	.36 - .38
Calcium acetate, bags	2.10 -.....	2.10 -.....	2.10 -.....
Arsenate, dr., lb.	.06½- .07	.06½- .07	.06 - .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., del., ton	20.00 -33.00	20.00 -33.00	20.00 -33.00
flake, dr., del., ton	22.00 -35.00	22.00 -35.00	22.00 -35.00
Phosphate, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Carbon bisulphide, drums, lb.	.05½- .06	.05½- .06	.05½- .06
Tetrachloride drums, lb.	.05½- .08½	.05½- .06	.05½- .06
Chlorine, liquid, tanks, wks., lb.	2.15 -.....	2.15 -.....	2.15 -.....
Cylinders	.05½- .06	.05½- .06	.05½- .06
Cobalt oxide, cans, lb	1.41 - 1.51	1.41 - 1.51	1.29 - 1.35
Copperas, bgs., f.o.b., wks., ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Copper carbonate, bbl., lb	.11½- .19½	.11½- .16	.11½- .16
Sulphate, bbl., cwt.	5.65 - 5.90	4.85 - 5.10	3.85 - 4.00
Cream of tartar, bbl., lb.	.15 - .15½	.15 - .15½	.16½- .17
Diethylene glycol, dr., lb	.16½- .20½	.16½- .20½	.16½- .20½
Epsom salt, dom., tech., bbl., cwt.	1.80 - 2.00	1.80 - 2.00	1.80 - 2.00
Ethyl acetate, drums, lb.	.07 -.....	.07 -.....	.07½-.....
Formaldehyde, 40%, bbl., lb.	.05½- .06½	.05½- .06½	.06 - .07
Furfural, dr., lb	.10 - .17½	.10 - .17½	.10 - .17½
Fusel oil, ref., drums, lb.	.16 - .18	.16 - .18	.16 - .18
Glaubers salt, bags, cwt	.85 - 1.00	.85 - 1.00	.85 - 1.00
Glycerine, c.p., drums, extra, lb.	.31 -.....	.29 -.....	.14 - .14½
Lead:			
White, basic carbonate, dry casks, lb.	.09 -.....	.07½-.....	.06½-.....
White, basic sulphate, sck., lb.	.08½-.....	.06½-.....	.06 -.....
Red, dry, sck., lb.	.10 -.....	.08½-.....	.07 -.....
Lead acetate, white crys., bbl., lb.	.11½- .12	.11½- .12	.10½- .11
Lead arsenate, powd., bbl., lb.	.10½- .10	.09½- .10	.09 - .10
Lime, chem., bulk, ton	8.50 -.....	8.50 -.....	8.50 -.....
Litharge, pwd., csk., lb.	.09 -.....	.075-.....	.06 -.....
Lithophone, bags, lb	.04½- .04¾	.04½- .04¾	.04½- .05
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06 - .06½
Methanol, 95%, tanks, gal.	.33 -.....	.33 -.....	.33 -.....
97%, tanks, gal.	.34 -.....	.34 -.....	.34 -.....
Synthetic, tanks, gal.	.33 -.....	.35½-.....	.35½-.....
Nickel salt, double, bbl., lb.	.13 - .13¾	.13 - .13¾	.13 - .13¾
Orange mineral, csk., lb.	.13 -.....	.11½-.....	.10 -.....
Phosphorus, red cases, lb.	.40 - .42	.40 - .42	.44 - .45
Yellow, cases, lb.	.28 - .32	.28 - .32	.28 - .32
Potassium bichromate, casks, lb.	.08½- .09	.08½- .09	.07½- .08½
Carbonate, 80-85%, calc. csk., lb.	.07 - .07½	.07 - .07½	.07 - .07½
Chlorate, powd., lb	.08 - .08½	.08 - .08½	.08 - .08½
Hydroxide (c'stic potash) dr., lb.	.07 - .07½	.07 - .07½	.06½- .06¾
Muriate, 80% bgs., ton	23.00 -.....	23.00 -.....	22.00 -.....
Nitrate, bbl., lb	.05½- .06	.05½- .06	.05½- .06
Permanganate, drums, lb.	.18½- .19	.18½- .19	.18½- .19
Prussiate, yellow, casks, lb.	.15 - .16	.16 - .17	.18 - .19
Sal ammoniac, white, casks, lb.	.04½- .05	.04½- .05	.04½- .05
Salsoda, bbl., cwt.	1.00 - 1.05	1.00 - 1.05	1.00 - 1.05
Salt cake, bulk, ton	13.00 -15.00	13.00 -15.00	13.00 -15.00
Soda ash, light, 58%, bags, contract, cwt.	1.23 -.....	1.23 -.....	1.23 -.....
Dense, bags, cwt.	1.25 -.....	1.25 -.....	1.25 -.....
Soda, caustic, 76%, solid, drums, contract, cwt.	2.60 - 3.00	2.60 - 3.00	2.60 - 3.00
Acetate, works, bbl., lb.	.04½- .05	.04½- .05	.04½- .05
Bicarbonate, bbl., cwt.	1.75 - 2.00	1.75 - 2.00	1.85 - 2.00
Bichromate, casks, lb.	.06½- .07	.06½- .07	.05½- .06½
Bisulphate, bulk, ton	15.00 -16.00	15.00 -16.00	15.00 -16.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03 - .04
Chlorate, kegs, lb.	.06½- .06¾	.06½- .06¾	.06½- .06¾
Chloride, tech., ton	12.00 -14.75	12.00 -14.75	12.00 -14.75
Cyanide, cases, dom., lb.	.15½- .16	.15½- .16	.15½- .16
Fluoride, bbl., lb.	.07½- .08	.07½- .08	.07½- .08
Hyposulphite, bbl., cwt.	2.40 - 2.50	2.40 - 2.50	2.40 - 2.50
Metasilicate, bbl., cwt.	2.15 - 3.15	2.15 - 3.15	3.25 - 3.40
Nitrate, bags, cwt.	1.375-.....	1.375-.....	1.275-.....
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.022- .023	.022- .023	.022- .024
Prussiate, yel. drums, lb.	.10 - .11	.10 - .11	.11½- .12
Silicate (40° dr.) wks., cwt.	.80 - .85	.80 - .85	.80 - .85
Sulphide, fused 60-62%, dr., lb.	.02½- .03¼	.02½- .03	.02½- .03
Sulphite, cyrs., bbl., lb.	.02½- .02¾	.02½- .02¾	.02½- .02¾
Sulphur, crude at mine, bulk, ton.	18.00 -.....	18.00 -.....	18.00 -.....
Chloride, dr., lb.	.03½- .04	.03½- .04	.03½- .04
Dioxide, cyl., lb.	.07 - .08	.06½- .08	.07 - .07½
Flour, bag, cwt.	1.60 - 3.00	1.60 - 3.00	1.60 - 3.00
Tin Oxide, bbl., lb.	.58 -.....	.54 -.....	.51 -.....
Crystals, bbl., lb.	.44 -.....	.37½-.....	.37 -.....
Zinc, chloride, gran., bbl., lb.	.05 - .06	.05 - .06	.05 - .06
Carbonate, bbl., lb.	.12 - .13	.09 - .11	.09 - .11
Cyanide, dr., lb.	.36 - .38	.36 - .38	.36½- .38
Dust, bbl., lb.	.087- .07	.079- .07	.069- .07
Zinc oxide, lead free, bag., lb.	.05½-.....	.05½-.....	.05 -.....
5% lead sulphate, bags, lb.	.05½-.....	.05½-.....	.04½-.....
Sulphate, bbl., cwt.	2.65 - 3.00	2.65 - 3.00	2.65 - 3.00

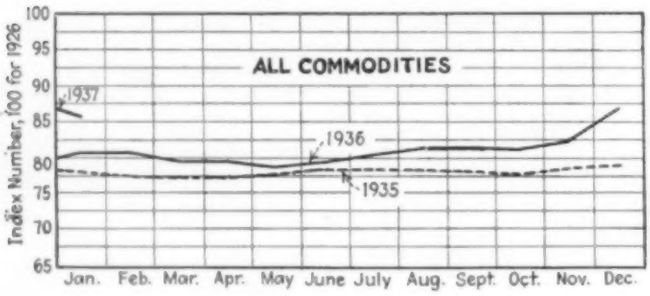
Oils and Fats

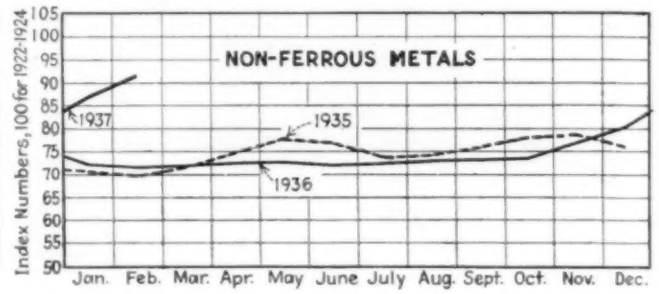
	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.10½-$0.11	$0.10½-$0.11	$0.10 -$0.11
Chinawood oil, bbl., lb.	.15½-.....	.15½-.....	.16½-.....
Coconut oil, Ceylon, tanks, N. Y. lb.	.09 -.....	.08½-.....	.04½-.....
Corn oil crude, tanks, (f.o.b. mill), lb.	.10 -.....	.10½-.....	.08½-.....
Cottonseed oil, crude (f.o.b. mill) tanks, lb.	.09½-.....	.10 -.....	.08½-.....
Linseed oil, raw car lots, bbl., lb.	.101-.....	.099-.....	.098-.....
Palm, casks, lb.	.06½-.....	.06½-.....	.04½-.....
Peanut oil, crude, tanks (mill), lb.	.10½-.....	.10½-.....	.08½-.....
Rapeseed oil, refined, bbl., gal.	.87 -.....	.85 -.....	.52 -.....
Soya bean, tank, lb.	.10 -.....	.10 -.....	.08 -.....
Sulphur (olive foots), bbl., lb.	.12½-.....	.11½-.....	.08½-.....
Cod, Newfoundland, bbl. gal.	.51 -.....	.48 -.....	.40 -.....
Menhaden, light pressed, bbl., lb.	.088-.....	.084-.....	.069-.....
Crude, tanks (f.o.b. factory), gal.	.40 -.....	.37 -.....	.36 -.....
Grease, yellow, loose, lb.	.08½-.....	.08½-.....	.04½-.....
Oleo stearine, lb.	.10½-.....	.10½-.....	.08½-.....
Red oil, distilled, d.p. bbl., lb.	.10½-.....	.10½-.....	.09½-.....
Tallow, extra, loose, lb.	.08½-.....	.08½-.....	.05½-.....

CHEM. & MET.'S WEIGHTED PRICE INDEXES









Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-napthol, crude, bbl., lb.	$055–$0.60	$0.60 –$0.65	$0.60 –$0.62
Refined, bbl., lb.	.80 – .85	.80 – .85	.80 – .85
Alpha-napthylamine, bbl., lb.	.32 – .34	.32 – .34	.32 – .34
Aniline oil, drums, extra, lb.	.15 – .16	.15 – .16	.14½– .15
Aniline salts, bbl., lb.	.24 – .25	.24 – .25	.24 – .25
Benzaldehyde, U.S.P., dr., lb.	1.10 – 1.25	1.10 – 1.25	1.10 – 1.25
Benzidine base, bbl., lb.	.65 – .67	.65 – .67	.65 – .67
Benzoic acid, U.S.P., kgs., lb.	.52 – .54	.52 – .54	.48 – .52
Benzyl chloride, tech., dr., lb.	.35 – .40	.35 – .40	.30 – .35
Benzol, 90%, tanks, works, gal.	.16 – .18	.16 – .18	.18 – .20
Beta-napthol, tech., drums, lb.	.23 – .24	.23 – .24	.24 – .27
Cresol, U.S.P., dr., lb.	.10 – .11	.10 – .11	.11 – .11¼
Cresylic acid, 99%, dr., wks., gal.	.73 – .75	.73 – .75	.58 – .60
Diethylaniline, dr., lb.	.55 – .58	.55 – .58	.55 – .58
Dinitrophenol, bbl., lb.	.23 – .25	.25 – .23	.29 – .30
Dinitrotoluen, bbl., lb.	.15 – .16	.15 – .16	.16 – .17
Dip oil, 25%, dr., gal.	.23 – .25	.23 – .25	.23 – .25
Diphenylamine, bbl., lb.	.32 – .36	.32 – .36	.38 – .40
H-acid, bbl., lb.	.55 – .60	.55 – .60	.65 – .70
Naphthalene, flake, bbl., lb.	.07½– .07¾	.07½– .07¾	.07 – .08
Nitrobensene, dr., lb.	.08½– .09	.08½– .09	.08½– .10
Para-nitraniline, bbl., lb.	.45 – .47	.45 – .47	.51 – .55
Phenol, U.S.P., drums, lb.	.13½– .14	.13½– .14	.14½– .15
Picric acid, bbl., lb.	.30 – .40	.30 – .40	.30 – .40
Pyridine, dr., gal.	1.10 – 1.15	1.10 – 1.15	1.10 – 1.15
Resorcinal, tech., kegs, lb.	.70 – .75	.70 – .75	.65 – .70
Salicylic acid, tech., bbl., lb.	.34 – .40	.34 – .40	.40 – .42
Solvent naptha, w.w., tanks, gal.	.26 –.....	.26 –.....	.26 –.....
Tolidine, bbl., lb.	.88 – .90	.88 – .90	.88 – .90
Toluene, tanks, works, gal.	.30 –.....	.30 –.....	.30 –.....
Xylene, com., tanks, gal.	.30 –.....	.30 –.....	.30 –.....

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton.	$22.00–$25.00	$22.00–$25.00	$22.00–$25.00
Casein, tech., bbl., lb.	.18½– .20	.19 – .20½	.14½– .15
China clay, dom., f.o.b. mine, ton.	8.00 –20.00	8.00 –20.00	8.00 –20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.04 – .20	.04 – .20	.04 – .20
Prussian blue, bbl., lb.	.37 – .38	.37 – .38	.37 – .38
Ultramarine blue, bbl., lb.	.10 – .26	.10 – .26	.10 – .26
Chrome green, bbl., lb.	.26 – .27	.26 – .27	.26 – .27
Carmine red, tins, lb.	4.00 – 4.40	4.00 – 4.40	4.00 – 4.40
Para toner, lb.	.75 – .80	.75 – .80	.80 – .85
Vermilion, English, bbl., lb.	1.72 – 1.75	1.72 – 1.75	1.59 – 1.60
Chrome yellow, C. P., bbl., lb.	.13 – .14	.13 – .14	.12 – .14
Feldspar, No. 1 (f.o.b. N.C.), ton.	6.50 – 7.50	6.50 – 7.50	6.50 – 7.50
Graphite, Ceylon, lump, bbl., lb.	.07 – .08½	.07 – .08½	.07 – .08½
Gum copal Congo, bags, lb.	.09 – .10	.09 – .10	.09 – .10
Manila, bags, lb.	.09 – .10	.09 – .10	.16 – .17
Damar, Batavia, cases, lb.	.13½– .16	.13½– .16	.15½– .16
Kauri No. 1 cases, lb.	.19 – .25	.19 – .25	.20 – .25
Kieselguhr (f.o.b. N. Y.), ton.	50.00 –55.00	50.00 –55.00	50.00 –55.00
Magnesite, calc, ton.	50.00 –.....	50.00 –.....	50.00 –.....
Pumice stone, lump, bbl., lb.	.05 – .07	.05 – .08	.05 – .07
Imported, casks, lb.	.03 – .40	.03 – .40	.03 – .35
Rosin, H., bbl.	10.60 –.....	10.80 –.....	5.75 –.....
Turpentine, gal.	.46 –.....	.47 –.....	.45½–.....
Shellac, orange, fine, bags, lb.	.25 –.....	.25 –.....	.26 –.....
Bleached, bonedry, bags, lb.	.21 –.....	.19½–.....	.24½–.....
T. N. bags, lb.	.14 –.....	.14 –.....	.14 –.....
Soapstone (f.o.b. Vt.), bags, ton.	10.00 –12.00	10.00 –12.00	10.00 –12.00
Talc, 200 mesh (f.o.b. Vt.), ton.	8.00 – 8.50	8.00 – 8.50	8.00 – 8.50
300 mesh (f.o.b. Ga.), ton	7.50 –10.00	7.50 –10.00	7.50 –11.00
225 mesh (f.o.b. N. Y.), ton.	13.75 –.....	13.75 –.....	13.75 –.....

INDUSTRIAL NOTES

RUBBER ASSOCIATES, INC., is the name of a company recently formed to engage in the manufacture and sale of chemical products and plastic materials. Sales offices are at 342 Madison Ave., New York. S. P. Tauber, M. R. Buffington, and H. R. Van Deventer are associated with the company.

HACKENSACK WATER CO., Hackensack, N. J., will rebuild the laboratories at its filtration and purification plant at New Milford, N. J., so as to give greater facilities for chemical and bacteriological testing and research.

CONSOLIDATED PRODUCTS CO., New York, has purchased the power plant of the Armour Fertilizer Works at Bartow, Fla.

THE MATHIESON ALKALI WORKS, INC., New York, has appointed The New York Quinine and Chemical Works, Inc., 99 N. 11th St., Brooklyn, as distributors of jobbing lots of its products in the metropolitan area.

PACIFIC WOOD TANK CORP., 461 Market St., San Francisco, Calif., has been formed by Fred W. Schmitz, Phil J. Maas and G. A. Patey. The company will provide a complete service of engineering, designing, and installing wood stave tank and pipe products.

COCHRANE CORP., Philadelphia, has consolidated sales of its equipment in New England under the Cochrane Steam Specialty Co., 80 Federal St., Boston. O. S. Pike will direct the sale of water treatment equipment and T. N. Graser will have charge of specialties and meters.

AMERICAN CAR & FOUNDRY CO., Philadelphia, has turned over sales of full area lubricated A. C. F. plug valves in that territory, to Sheffler-Gross Co., located in the Drexel Bldg.

THE LINCOLN ELECTRIC CO., Cleveland, as a result of flood conditions, has moved its Cincinnati office to the American Bldg., Central Parkway and Walnut St.

WITCO CARBON CO., New York, a company recently organized to produce and market carbon black, has appointed Carl J. Minnig as general sales manager.

New CONSTRUCTION

Where Plants Are Being Built in Process Industries

	Current Projects		Cumulative 1937	
	Proposed Work	Contracts	Proposed Work	Contracts
New England	$150,000	$40,000	$190,000	$80,000
Middle Atlantic	585,000	3,143,000	7,702,000	1,432,000
South	770,000	485,000	810,000	16,781,000
Middle West	1,603,000	210,000	2,683,000	2,309,000
West of Mississippi	5,000,000	2,300,000	6,230,000	3,160,000
Far West	.....	2,300,000	2,800,000	3,043,000
Canada	200,000	40,000	330,000	40,000
Total	$8,308,000	$8,518,000	$20,745,000	$26,845,000

PROPOSED WORK

BIDS ASKED

Chemistry Building—Commonwealth of Massachusetts, Dept. of Education, Lowell Textile Institute, C. H. Eames, Pres., Moody St., Lowell, Mass., contemplates the construction of a 3 story Chemistry Building. Estimated cost $150,000.

Chemical Plant—Dow Chemical Co., Midland, Mich., plans to improve and construct additions to its plant here. Estimated cost $1,000,000.

Chemical Factory—Florasynth Laboratories Co., Ltd., c/o Albert Ellison, 437 St. James St., Montreal, Que., Can., plans to construct a factory for the manufacture of chemical products. Estimated cost $50,000.

Distillery—Penfield Co., M. H. Greulich, Mgr., Carew Tower, Cincinnati, O., plans to enlarge the plant of the Toms Bixler Distilling Co. near Frankfort, Ky. Estimated cost $300,000.

Factory—Compressed Industrial Gases, Inc., 221 North La Salle St., Chicago, Ill., are having plans prepared for a factory at Shreveport, La. Estimated cost between $50,000 and $60,000.

Factory—Eastern Tar Products Corp., Lexington Bldg., Baltimore, Md., plans to construct a factory at Money Point, Norfolk, Va. Estimated cost $60,000.

Factory—Johns-Manville Corp., 22 East 40th St., New York, N. Y., plans to improve its factory at Waukegan, Ill. Owner will finance from proceeds of a stock issue. Estimated cost $273,000.

Factory—National Aniline & Chemical Co., Abbott Rd., Buffalo, N. Y., is receiving bids for an addition to its factory.

Glass Factory—Corning Glass Works, Walnut St., Corning, N. Y., is having plans prepared for a 3 story, 60x100 ft. addition to its plant on Tioga St. Estimated cost $75,000.

Laboratory—Bayer-Semesan Co., Inc., c/o E. S. Miles, Du Pont Bldg., Wilmington, Del., is having plans prepared for a field laboratory plant at Minquadale, Del. Engineering Dept., E. I. Du Pont De Nemours & Co., Du Pont Bldg., Wilmington, engrs.

Laboratory—Bendix Aviation Corp., South Bend, Ind., contemplates the construction of a plant at Teterboro, N. J., to include laboratory.

Laboratory—Pittsburgh Plate Glass Co., Columbia Chemical Division, Barberton, O., is receiving bids for additions to its laboratory and office buildings. Estimated cost $150,000.

Paper Mill—Southland Paper Mills, Inc., c/o Perkins-Goodwin Co., 30 Rockefeller Plaza, New York, N. Y., plans to construct a paper mill in Texas. Exact location is still undecided. Estimated cost $5,000,000.

Radium Refinery—Eldorado Gold Mines, Ltd., Gilbert Labine, Mgr., Port Hope, Ont., Can., are having plans prepared by Kribs & Lynar, Engrs., 603 Harbor Comn. Bldg., Toronto, Ont., for a 3 story addition to radium refinery. New equipment will include filters and crystallization equipment, also chemical and physics laboratories. $150,000.

Rayon Plant—E. I. DuPont De Nemours & Co., Wilmington, Del., contemplates the construction of a rayon plant at Macon, Ga. Estimated cost will exceed $150,000.

Research Building—Gulf Oil Co., Gulf Bldg., Pittsburgh, Pa., will soon award the contract for the construction of a research building near Harmarville, Pa.

Refinery—Bradford Oil Refining Co., J. P. Andrews, Gen. Mgr., Bradford, Pa., is receiving bids for the construction of a cracking unit, reforming unit, solvent dewaxing plant and extensions to boiler and filter plant at crude oil refinery. Estimated cost $350,000.

Roofing Factory—Bird & Son, Inc., East Walpole, Mass., plans to construct a factory at Shreveport, La. Estimated cost $200,000.

Rubber Factory—Dayton Rubber Mfg. Co., West Riverview Ave., Dayton, O., plans to construct a 2 story, 100x140 ft. addition to its factory, also two 1 story warehouses. Geyer & Neuffar, Ludlow Arcade Bldg., Dayton, Archts. Estimated cost $100,000.

Rubber Factory—B. F. Goodrich Co., 500 South Main St., Akron, O., has acquired the plant formerly occupied by the Acme Motor Truck Co., Cadillac, Mich., and plans to alter and improve same for its own use. Estimated cost including equipment will exceed $40,000.

Rubber Factory—Marathon Rubber Products Co., Wausau, Wis., will soon receive bids for the construction of a 1 story, 60x87 ft. addition to its factory. Oppenhomer & Obel, Wausau, Archts.

Calcium Chloride—Dept. of Purchase, Erie County, 263 Terrace St., Buffalo, N. Y., will receive bids until March 10, for a large quantity of calcium chloride to be used on county highways during 1937. E. T. Hunt, Purchasing Agt.

CONTRACTS AWARDED

Carbon Black Plant—Witco Carbon Co., Sunray, Tex., c/o Shamrock Oil & Gas Co., Amarillo, Tex., and Pittsburgh, Pa., will construct a carbon black plant at Sunray. Work will be done by separate contracts. Estimated cost $1,250,000.

Cement Factory—Gulf Portland Cement Co., Houston and Fort Worth, Tex., has awarded the contract for the construction of a cement factory on the Houston Ship Channel to Horton & Horton, 1230 Baker St., Houston. Estimated cost $400,000.

Chemical Plant—California Chemical Co., Newark, Calif., has awarded the contract for the construction of a chemical plant to H. K. Ferguson Co., Hanna Bldg., Cleveland, Ohio. Address owner care of contractor. Estimated cost $1,000,000.

Chemical Plant—National Aniline & Chemical Co., Abbott Rd., Buffalo, N. Y., has awarded the contract for Building No. 70 to Frank C. Huber, 860 Hertel Ave., Buffalo, N. Y.

Clay Factory—Dutch Mountain Clay Products Co., Inc., Dallas and Lopez, Pa., will construct a factory at Lopez. Work will be done by day labor and separate contracts. $40,000.

Cottonseed Oil Mill—Fidelity Products Co., Brownsville, Tex., subsidiary of Wesson-Oil-Snowdrift Co., New Orleans, La., plans to construct a cotton seed oil mill at Harlingen, Tex. Work will be done by separate contracts. $150,000.

Distillery—A. B. Blanton Distillery Co., Frankfort, Ky., has awarded the contract for an addition to its distillery to Frank Messer & Sons, 2515 Burnet Ave., Cincinnati, O. Estimated cost $65,000.

Factory—Atlas Powder Co., Delaware Trust Bldg., Wilmington, Del., has awarded the steel contract for a factory at Rose Hill, Wilmington, to McCormick Construction Co., Third and Orange Sts., Wilmington, Del. Estimated cost $2,500,000.

Factory—Johnson & Johnson, Ltd., 215 Pir Ninth Blvd., Montreal, Que., Can., has awarded the contract for an addition to its factory to A. F. Byers Co., Ltd., 1226 University Ave., Montreal. Estimated cost $40,000.

Factory—Linde Air Products Co., 205 East 42nd St., New York, N. Y., has awarded the contract for the construction of a factory on Buckeye St., Toledo, O., to John W. Cowper Co., 775 Main St., Buffalo, N. Y. Estimated cost $65,000.

Factory—Resinous Products & Chemical Co., 222 West Washington Sq., Philadelphia, Pa., has awarded the contract for the construction of a factory on Richmond St., Philadelphia, to Frank V. Warren, Inc., Lewis Tower Bldg., Philadelphia. Estimated cost $86,000.

Gas Generating Plant—Municipality, Alexander City, Ala., has awarded the contract for the construction of a butane air gas generating plant to C. I. Tenney Engineering Co., 311 Frontenac Bldg., Minneapolis, Minn. Estimated cost $20,300.

Glass Factory—Corning Glass Works, Walnut St., Corning, N. Y., has awarded the contract for an addition to its plant on Tioga St. to H. K. Ferguson Co., Hanna Bldg., Cleveland, O. Estimated cost $90,000.

Laboratory—New York State Dept. of Education, State Office Bldg., Albany, N. Y., has awarded the contract for the construction of a laboratory at New York State Veterinary College to C. F. Haglin, Inc., and Winston Bros., 2713 Main St., Buffalo. Estimated cost $272,000.

Mill Building—Nashua Gummed & Coated Paper Co., 44 Franklin St., Nashua, N. H., has awarded the contract for the construction of a mill building on Franklin St., Nashua, to Morton C. Tuttle Co., 862 Park Sq. Bldg., Boston, Mass. Estimated cost $40,000.

Oil Refinery—Shell Petroleum Co., Shell Bldg., Houston, Tex., has awarded the contract for the construction of an oil refinery to Alco Products Co., Dunkirk, N. Y. Estimated cost $500,000.

Paper Mill—Sonoco Products Co., Hartsville, S. C., has awarded the contract for the construction of a paper mill and steam power plant to Fiske-Carter Construction Co., Spartanburg, S. C. $400,000.

Pulp Mill—Soundview Pulp Co., Everett, Wash., has awarded the contract for the construction of a pulp mill to Austin Co., Dexter Horton Bldg., Seattle, Wash. Estimated cost including equipment $1,300,000.

Roofing Factory—Lloyd A. Fry Roofing Co., 5300 West 66th St., Chicago, Ill., has awarded the contract for a roofing factory to Thomas & Belz Co., Memphis, Tenn. $45,000.

Rubber Factory—Baldwin Rubber Co., Pontiac, Mich., has awarded the contract for an addition to its plant to Darin & Armstrong, Pontiac. Estimated cost $100,000.

Tannery—Elk Tanning Co., subsidiary United States Leather Co., 27 Spruce St., New York, N. Y., has awarded the contract for the construction of a tannery to Hyde Murphy Co., Race St., Ridgway, Pa. Estimated cost $35,000.

Warehouse—A. P. W. Paper Co., 1273 Bway., Albany, N. Y., has awarded the contract for the construction of a warehouse on Bridge St., to John P. Sewell, 372 Hudson Ave., Albany. $40,000.

Warehouses—Riegel Paper Corp., 342 Madison Ave., New York, N. Y., has awarded the contracts for three warehouses at Milford, N. J., to Austin Co., Commercial Trust Bldg., Philadelphia, Pa.

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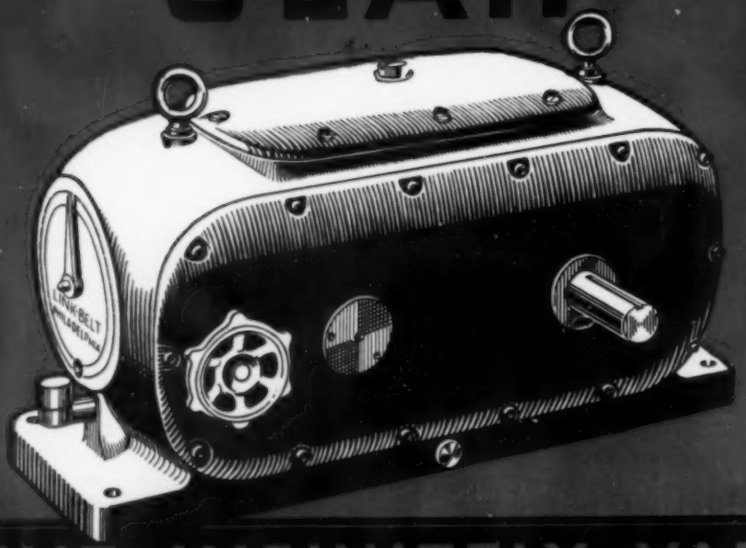

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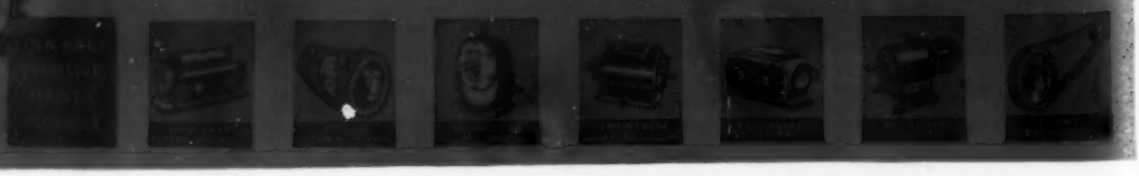
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